SONY

C-283-100-**12** (1)

Digital Video Camera Module

Technical Manual

XCG-CG160/CG160C
XCG-CG240/CG240C
XCG-CG510/CG510C

Table of Contents

Overview

Connections

Functions

Specifications

Overview

Before operating the unit, please read this manual thoroughly and retain for future reference.

This unit is a digital video camera module that adopts the 1000BASE-T/100BASE-TX interface.

This operating instruction of the digital video camera module covers:
- XCG-CG160/CG240/CG510 (monochrome models)
- XCG-CG160C/CG240C/CG510C (color models)

In this document, we refer to “Digital Video Camera Module” as “the unit”, “XCG-CG160/CG240/CG510” as “Monochrome camera”, and “XCG-CG160C/CG240C/CG510C” as “Color camera”.

Features

GigE Vision compliant

This unit supports GigE Vision Ver.2.0/Ver.1.2, and the versions are switchable by changing the settings.

IEEE1588 compliant

This precision clock synchronization via network protocol conforms to the defined IEEE1588 standard. This unit can synchronize the exposures of multiple cameras via an Ethernet cable.

High image quality

This unit produces stable output images, by adopting the latest CMOS image sensors with a global shutter function.
By adopting the square pixel image sensor, images can be processed using the original aspect ratio without a converting procedure.
The following models and resolutions of their image sensors are shown below.

Model name	Pixel number
XCG-CG160/CG160C	1,580,000-pixel
XCG-CG240/CG240C	2,350,000-pixel
XCG-CG510/CG510C	5,070,000-pixel

Various settings

Sending a command from the host device allows various settings, including the following.
- Gain
- Shutter
- Partial scan
- Trigger control
- LUT (Look Up Table)
- Output: 8/10/12-bit, RGB 24-bit, YUV 24-bit (YUV444), or YUV 16-bit (YUV422)
- Pixel defect correction function
- Shading correction function
- Area gain function

External trigger shutter function

By synchronizing with an external trigger signal, any shutter timing can be used.

Partial scan

The camera module can limit the number of video output lines to achieve high frame rates, enabling high-speed image processing.

Body fixing

The screw holes to install the camera module are located under the front panel (the image sensor reference plane). Installing the camera module on the front panel minimizes deviation of the optical axis.

LUT (Look Up Table)

You can switch to OFF or ON. When set to ON, you can select from five preset values, such as inversion, binarization, settable five-point approximations, etc.

Switching an Output Bit Length

You can select 8-bit output, 10-bit output, or 12-bit output.
For color models, you can also select an output of RGB 24-bit, YUV 24-bit (YUV444), or YUV 16-bit (YUV422).

White balance control (color camera only)

You can adjust the R and B level against G level to adjust the white balance. This unit is also equipped with the one-push white balance function, by which the camera can automatically adjust the white balance.

Area gain function

You can set the gains between 0 to 32 times for a preference position (up to 16 positions). If the set area is duplicated, the low-numbered area takes priority.

Equipped with temperature sensor

This unit can readout the temperature inside of the camera from the temperature sensor installed on the module board. If the update interval of the temperature sensor value is set to other than 0, the temperature information can be sent to a PC application as event data.

Defect correction function

This unit is equipped with the function that reduces the sensor defect, and it can be switched On/Off.

Shading correction function

This unit is equipped with the function that corrects the shadings caused by a light source and lens, and it can be switched On/Off.

Binning function (XCG-CG160 only)

Adding 2 pixels in the vertical and horizontal directions achieves higher sensitivity and frame rate.

Phenomena Specific to Image Sensors

Note

The following phenomena that may occur in images are specific to image sensors.
They do not indicate a malfunction.

White flecks

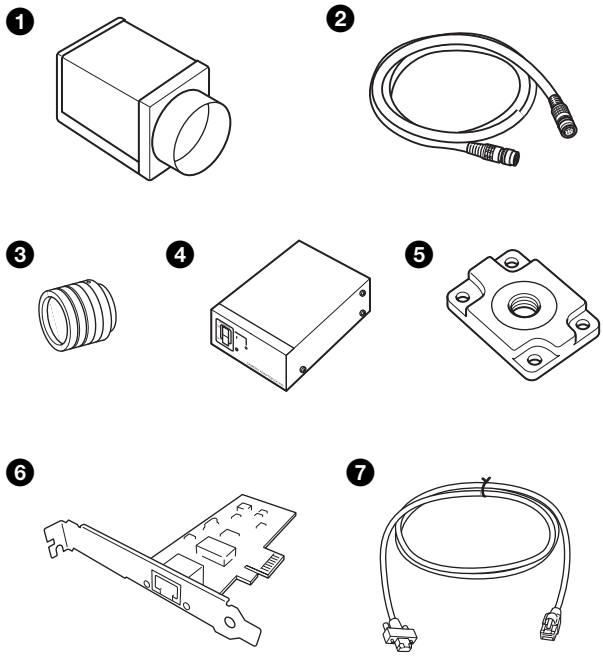
Although the image sensors are produced with high-precision technologies, fine white flecks may be generated on the screen in rare cases, caused by cosmic rays, etc.
This is related to the principle of image sensors and is not a malfunction.
The white flecks especially tend to be seen in the following cases:

- when operating at a high environmental temperature
- when you have raised the gain (sensitivity)
- when using the slow shutter

Aliasing

When fine patterns, stripes, or lines are shot, they may appear jagged or flicker.

System Components



The video camera module system comprises the following optional products (available separately).

❶ Video Camera Module
This is a small-size, high image-quality video camera module that uses CMOS image sensors with a global shutter function.

❷ Camera cable
This is attached to the DC IN connector of the camera module and is used for power supply and exchange of trigger signals.
For purchasing the cable, consult the dealer.

❸ C-mount lens
Use a suitable lens to fit the camera pixel count.

❹ DC-700/700CE camera adaptor
This is connected to the camera module to enable power supply from ordinary AC power source.

❺ VCT-333I tripod adaptor
This attaches to the bottom of the camera module to fix the camera module to a tripod.

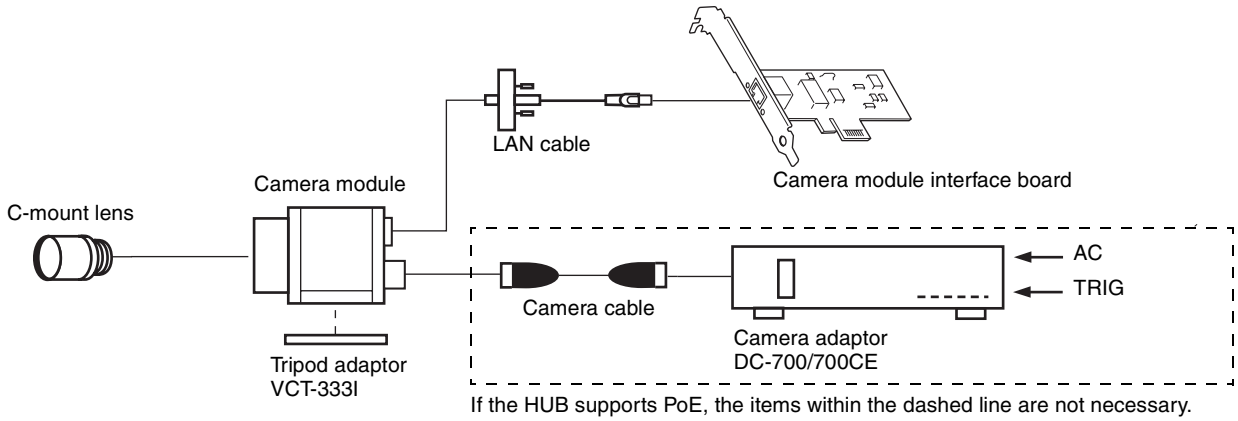
❻ Camera module interface board
Install the board in the expansion slot of the host device (ex: computer). Use a board that is appropriate for your system and that supports 1000BASE-T (or allows 100BASE-TX when it is used) and jumbo packets.

❼ LAN cable
This cable connects to the RJ45 connector on the rear panel of the camera module.
Image/control signals are transmitted via this cable. Use a LAN cable (CAT5e or higher standard) that supports 1000BASE-T (or allows 100BASE-TX when it is used). Depending on the attributes of the LAN cable, images may become less clear and the camera module may become unstable. Be sure to use a LAN cable that has sufficient noise reduction.

Note

When you connect the LAN cable of the unit to peripheral device, use a shielded-type cable to prevent malfunction due to radiation noise.

Connection



Power supply
You can supply power to the camera module using the following methods.

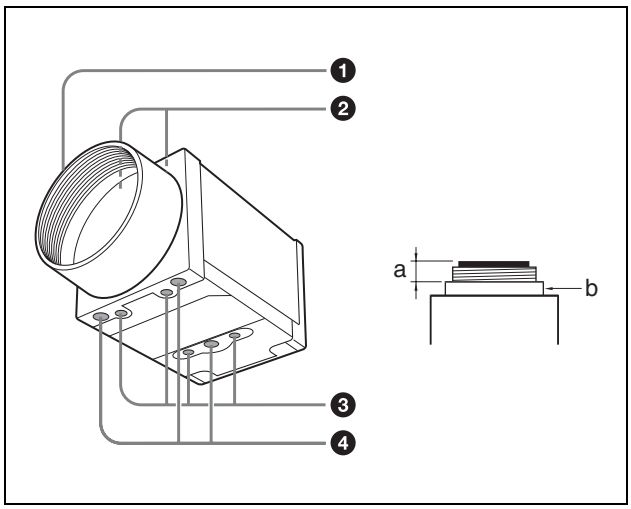
Using the RJ45 connector
This unit supports PoE (IEEE802.3af standard). By using a PoE-compatible LAN cable and camera module interface board or hub, you can power, control, and output images from the camera using one LAN cable.

Using the DC IN connector
You can supply power via the DC IN connector using the power adapter.
Use DC-700/700CE which is the stable power source free from ripple or noise.

Heat dissipation
For heat dissipation, refer to When mounting the camera (see page 9).

Location and Function of Parts and Operation

Front/Top/Bottom



❶ Lens mount (C-mount)
Attach any C-mount lens or other optical equipment.

Note

Use a C-mount lens with a protrusion (a) extending from the lens mount face (b) of 10 mm (13/32 inch) or less. The performance of a lens may change according to the aperture level.
If the resolution is not enough, adjust the aperture level.

❷ Guide screw holes (Top)

❸ Guide screw holes/Tripod screw holes (bottom)
When using a tripod, use these four screw holes to attach a VCT-333I tripod adaptor.

❹ Reference screw holes (bottom)
These precision screw holes are for locking the camera module. Locking the camera module into these holes secures the optical axis alignment.

Note

Refer to XCG-CG240 Demensions in page 59 for about the position/size of the Guide hole and the Reference hole.

Using a tripod

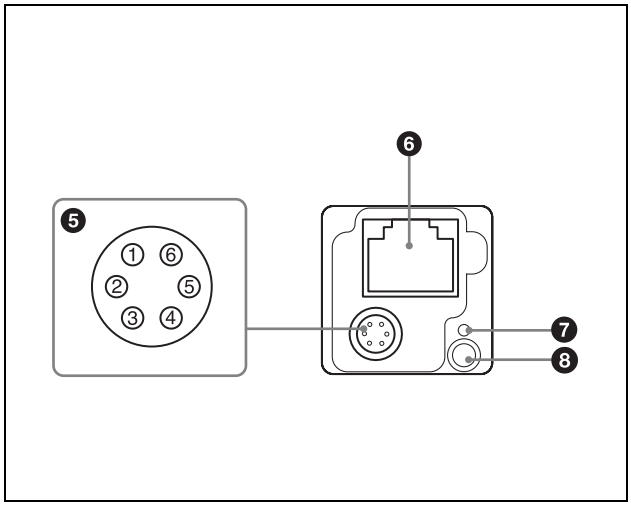
To use the tripod, install the tripod adaptor VCT-333I (not supplied) on the camera module.
Use a tripod screw with a protrusion (ℓ) extending from the installation surface, as follows, and tighten it, using a screwdriver. Be sure that the protrusion (ℓ) does not exceed 5.5 mm (0.2 in.) in length.

Length 4.5 to 5.5 mm
Length 0.18 to 0.22 inches

Note

If you install a tripod adapter (not supplied), use the screws provided.

Rear



❺ ⎓ (DC power input) connector (6-pin)
You can connect a camera cable to input the +12 V DC power supply. The pin configuration of this connector is as follows.
(Refer to Fig. ❻ above for the pin assignment of the connector.)

Pin No.	Signal	Pin No.	Signal
1	DC input (10.5 V to 15 V)	4	GPI3/GPO3 (GPO3 (ISO +)*)
2	GPI1 (ISO +)	5	ISO –
3	GPI2/GPO2	6	GND

*XCG-CG160/CG160C only

❻ RJ45 connector
You can connect a LAN cable to this connector to control the camera module from a host device to output image to a host device. By using a PoE-compatible LAN cable and camera module interface board or hub, you can supply power using the LAN cable.

Note

For safety, do not connect the connector for peripheral device wiring that might have excessive voltage to this port. Follow the instructions for this port.

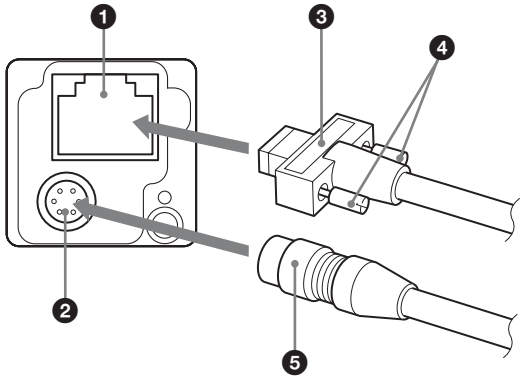
❼ Reset switch
The camera can be reset to the factory setting by pressing the reset switch for more than 3 seconds while the power is turned on.

Notes

- All the setting items will be deleted.
- Formatting is performed after operation.
  Do not turn off the power for 1 minute after the LED lights again.

❽ Status LED (Green)
Displays the unit status.
For details, see “Status LED” (page 43).

Connecting the cables



Connect the camera cable (❺) to the DC IN connector (❷) and connect the LAN cable (❸) to the RJ45 connector (❶) respectively. If you use a camera module interface board or a hub that supports PoE, you can operate the camera even if you do not connect the camera cable to the DC IN connector. When you connect the LAN cable with fastening screws, turn the two screws (❹) on the connector to secure the cable tightly.

Connect the other end of the camera cable to the DC-700/700CE and the other end of the LAN cable to the camera module interface board or a hub.

Note

Do not supply power to the camera cable and LAN cable at the same time.

When mounting the camera

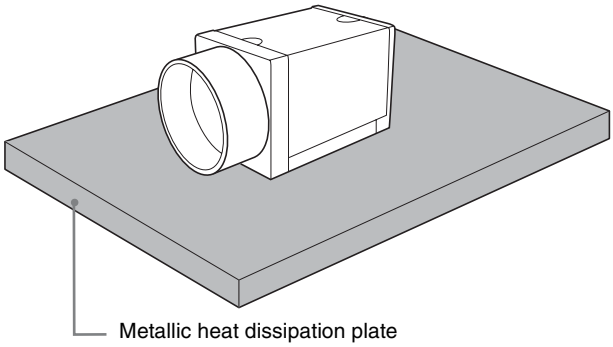
When the value read from temperature sensor is above 75 °C (167 °F), heat dissipation is required.

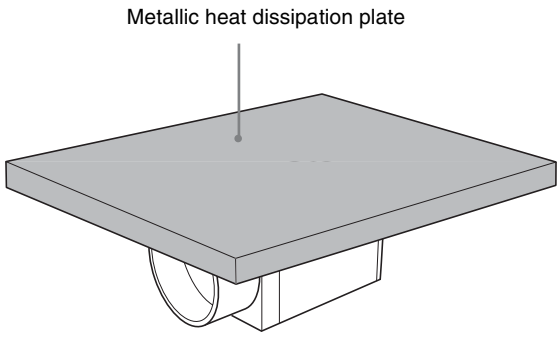
* For CG160/CG160C, in addition to the above condition, use in environments where the difference with the ambient temperature is 34°C or less.

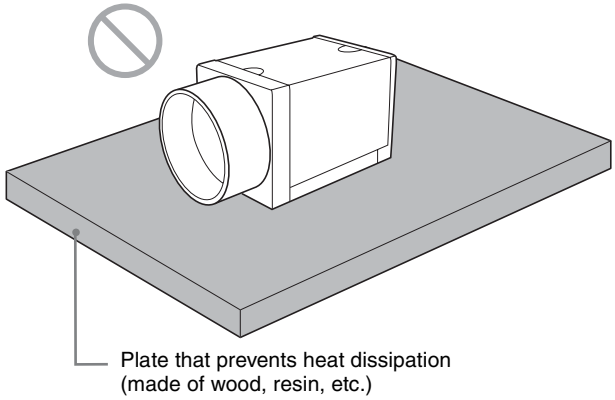
To promote heat dissipation from the unit and maintain performance, mount the camera to a metallic heat dissipation plate.
Dimension of the heat dissipation plate: 160 mm × 130 mm × t5 mm or more (Thermal conductivity: 16.3 W/m·K or more)

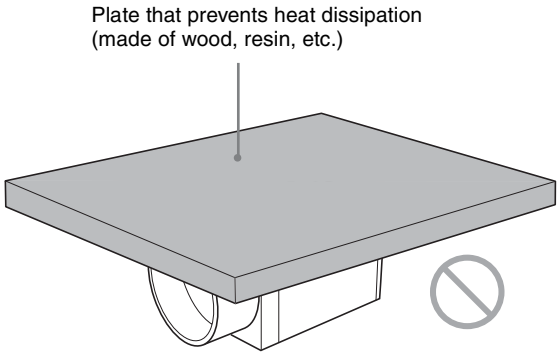
Notes

- When mounting the camera to the heat dissipation plate, secure the camera tightly by using the reference screw holes (see page 7) and screws.
- Do not mount the camera to a plate made of a material such as wood or resin that prevents heat dissipation.









Network Settings

For the camera to be connected to a network, the following address data must be properly specified:
- IP address
- Subnet mask
- Default gateway

The camera provides the following three methods for the address data setting:
- Using Persistent IP
- Using DHCP
- Using Link Local Address (LLA)

Using Persistent IP

Use this method when the IP address to be assigned to the camera has been specified in advance. When you use a fixed IP, setting of subnet mask is necessary. To use beyond the router, you need to set the default gateway as well.

Using DHCP

The camera is equipped with a function to automatically obtain an IP address by communicating with a DHCP server on a network. When using the DHCP method for IP address setting, the subnet mask and default gateway values automatically obtained from the DHCP server are also used.

Using LLA

If neither Persistent IP nor DHCP is used, or if an IP address cannot be obtained from the DHCP server, the IP address is determined by LLA. The IP address determined by LLA will be 169.254.XXX.YYY, with XXX and YYY automatically specified.

Packet Size

The amount of image data per packet can be set in bytes. To permit the camera to operate properly, set the packet size to a value less than the MTU of the network device connected to the camera. Set the largest value in the networks including the hub.

Packet Delay

The delay amount to be inserted between packets can be set when sending them to a network. By increasing the packet delay, you can reduce the network bandwidth that the camera uses for sending packets. However, as the amount of data sent in a certain time is decreased with increased delay, the frame rate of output images of the camera may be consequently decreased.

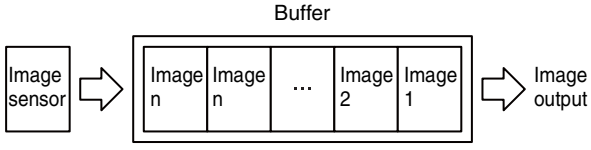
Network connection speed

This unit supports the connection with 1000Base-T (1 Gbps) or 100Base-TX (100 Mbps).
When you connect the unit to the network, negotiate the communication speed with the connected equipment and start communication at a higher speed of that both equipment are compatible with.
When using the unit with 100Base-TX connection, the frame rate to be output is limited, because the output data band width from the camera becomes narrow compared to the 1000Base-T connection.
The camera has a buffer to store multiple images and all of the shot images are stored once in the buffer.
The stored images are output from the camera in order starting from the oldest image in the buffer.
Therefore, if the frame rate during shooting is faster than the frame rate that can be output from the camera, the image data will always be stored in the buffer, and the time interval from shooting to image output becomes large.
To avoid this situation, it is required to set the shooting frame rate to the proper value when using 100Base-TX connection.
The data rate of images is obtained by the following formula:

Data rate = Width × Height × BPP × FPS
Width: Width of image
Height: Height of image
BPP: The number of bits per pixel depends on the PixelFormat setting

Mono8/BayerRG8	8-bit
Mono10Packed/BayerRG10Packed	12-bit
Mono12Packed/BayerRG12Packed	12-bit
RGB8Packed/BRG8Packed/YUV8_UYV	24-bit
YUV422_8/YUV422_8_UYVY	16-bit

FPS: Frame rate [frame/sec]
It is possible to minimize delay by using the camera at a frame rate where the data rate becomes low with a margin against 100 Mbps.



Notes

- Any persistent IP address can be entered, but the camera may become unable to be detected, depending on the IP address setting. If this occurs, use a tool for issuing ForceIP and set a persistent IP address again.
- When setting the parameters (Width, Height, and PixelFormat) for calculating the payload size, stop camera image output beforehand.

Trigger Signal Input

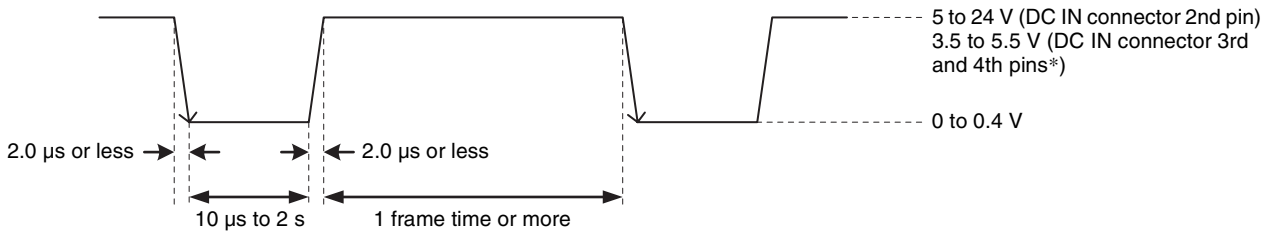
Trigger signals can be input via the 2nd, 3rd, 4th pins of the DC IN connector, or the software command. Switchover of the trigger signal can be changed via the TriggerSource register.

Trigger signal polarity

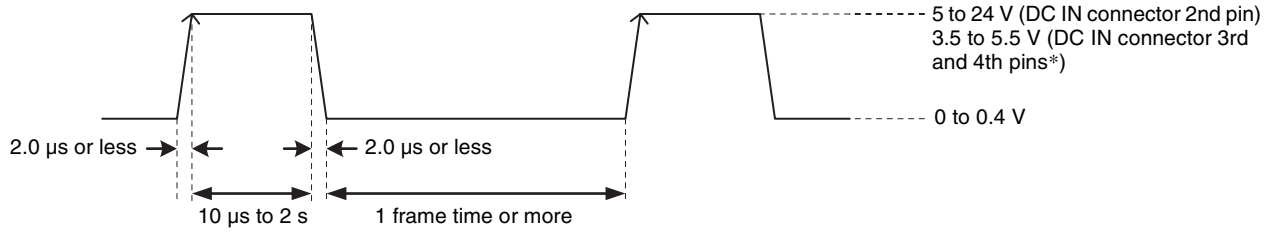
Positive refers to a trigger signal polarity activated while rising from Low to Hi, or during the Hi interval. Negative refers to a trigger signal polarity activated while falling from Hi to Low, or during the Low interval.

Register	Parameter	Setting
TriggerActivation	FallingEdge (0)	Negative
	RisingEdge (1)	Positive

DC IN connector specifications



Trigger input polarity = Negative



Trigger input polarity = Positive

* XCG-CG160/C160C: Unavailable. Dedicated to output.

Note

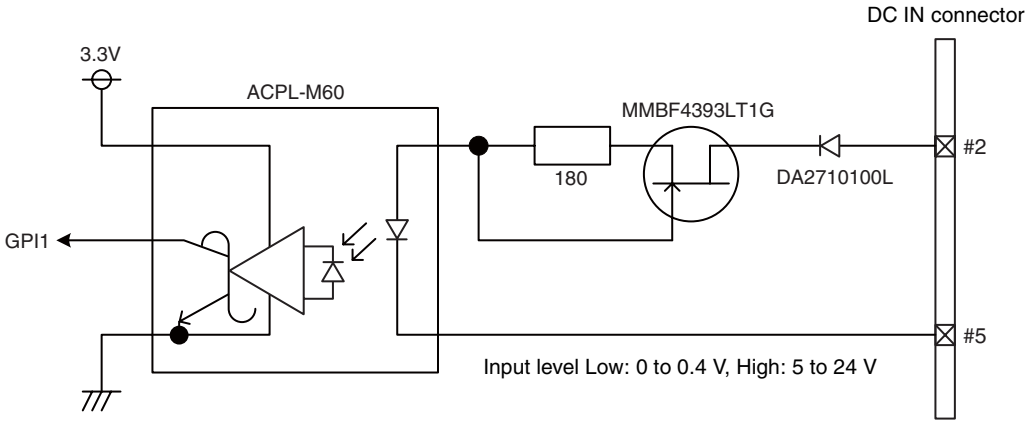
- When inputting a trigger signal to the camera using the DC-700/CE, use DC 5 V or less at the logical high level.
- Make sure to supply power to the camera module and confirm that the camera module is operating before inputting a trigger signal. If you input trigger signal to a camera module without the power supplied, this may cause a malfunction of the camera module.

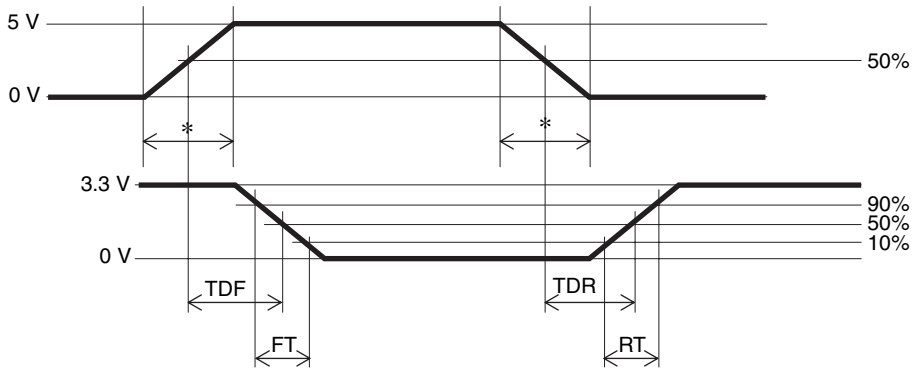
GPIO Connector

The DC IN connector #2 is the GPI connector. #3 and #4 connectors can be set as GPI/GPO.* The trigger reset pin is the DC IN connector 2nd pin (GPI1). If you are connecting an external device to the GPI or GPO connector, refer to the circuit specifications below.

* #4 is GPO connector only for XCG-CG160/CG160C.

GPI circuit specifications





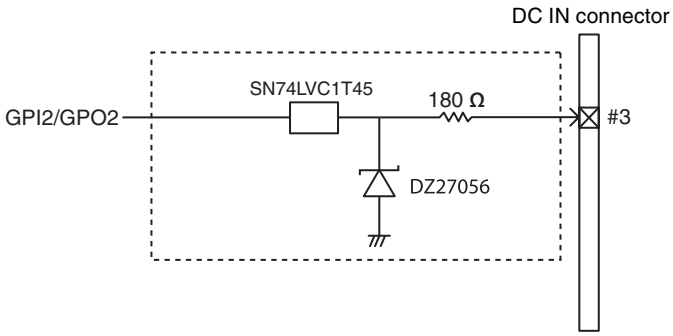
* Rising the input signal as soon as possible.

Example

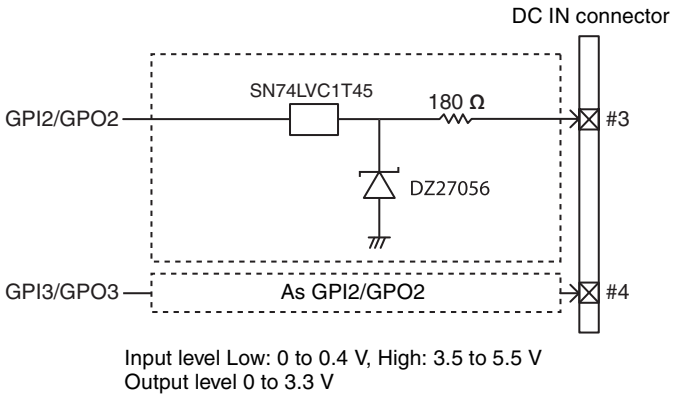
Input voltage [V]	TDF [ns]	FT [ns]	TDR [ns]	RT [ns]
5.0	167	297	192	358

GPIO circuit specifications

XCG-CG160/CG160C



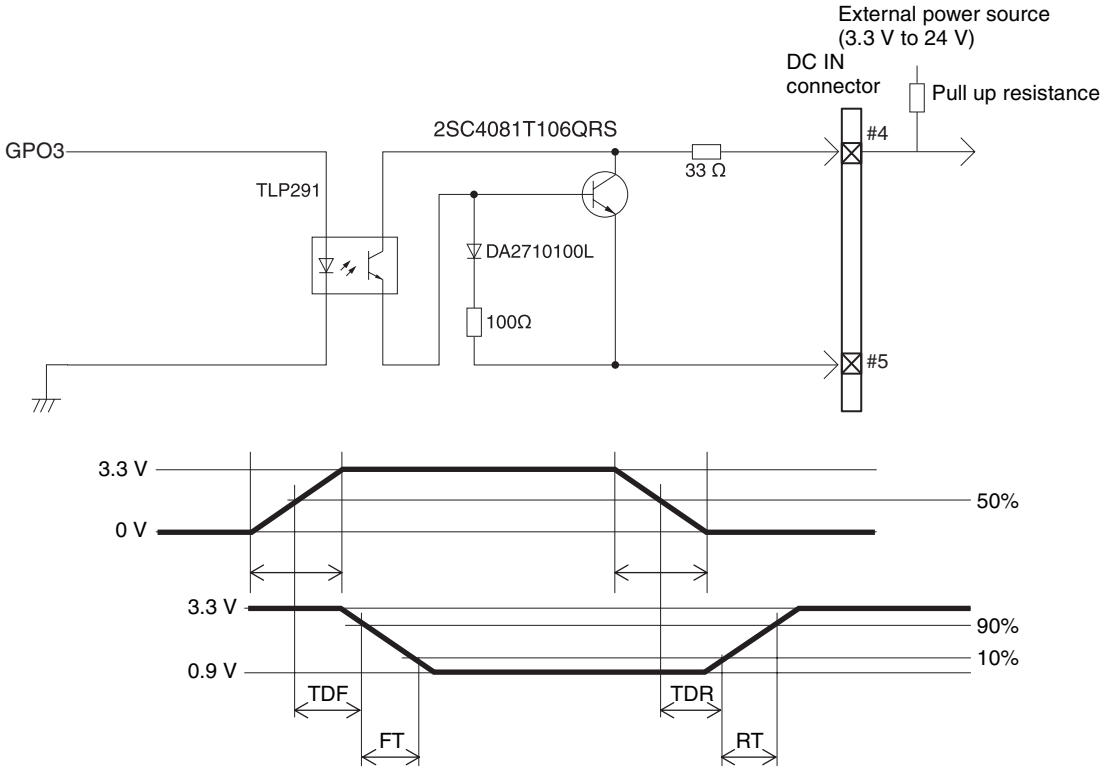
XCG-CG240/CG240C
XCG-CG510/CG510C



Input level Low: 0 to 0.4 V, High: 3.5 to 5.5 V
Output level 0 to 3.3 V

GPO circuit specifications

XCG-CG160/CG160C



Example

When connecting to an external power supply, be sure to use a pull-up resistor for a current limit of less than 50 mA.

	Supply voltage of the output [V]	Pull-up resistor (Use 1/16 W)	Current [mA]	TDF [µs]	FT [µs]	TDR [µs]	RT [µs]	Output voltage [V]
Normal temperature	3.3	470 Ω	5.07	0.75	0.49	24	35	0.916
	5.0	820 Ω	4.98	0.73	0.63	28	46	0.909
	12.0	Two 2200 Ω resistors in parallel	9.87	0.71	1.05	36	64	1.112
	24.0	Eight 8200 Ω resistors in parallel	21.85	0.73	1.45	45	76	1.571

Partial Scan

Only the area selected from the effective pixel area can be read out. Adding 2 pixels of vertical and horizontal directions achieves higher sensitivity and frame rate. The area size is selected by the Height and Width registers, and the read beginning point is selected by the OffsetX and OffsetY registers. Reducing Height increases the frame rate, but changing the Width register does not change the frame rate. Partial scan can be set with or without a trigger.
OffsetX and OffsetY relate to Width and Height as follows:
OffsetX + Width ≤ Width (maximum value)
OffsetY + Height ≤ Height (maximum value)

Note

Since the shutter setting has priority, use a shutter speed high enough to enable partial scan at a higher frame rate.

Configurable range

	Width	Height
XCG-CG160/ CG160C	16 to 1440 to 1456	16 to 1080 to 1088
XCG-CG240/ CG240C	16 to 1920 to 1936	16 to 1200 to 1216
XCG-CG510/ CG510C	16 to 2448 to 2464	16 to 2048 to 2056

Configurable values

The values of OFFSETX, OFFSETY, WIDTH and HEIGHT increase or decrease in steps of 4.

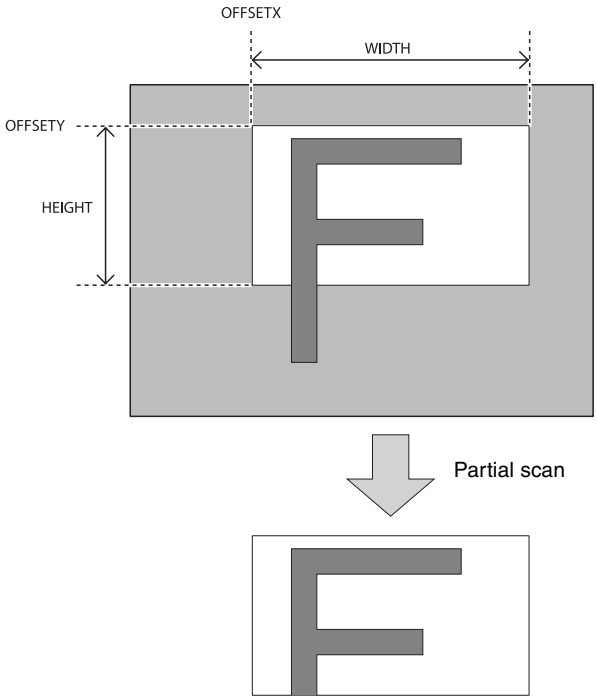
Binning (XCG-CG160 only)

Adding 2 pixels in the vertical and horizontal directions achieves higher sensitivity and frame rate.

Register	Parameter	Setting
BinningVertical	1	Vertical binning is not available
	2	Vertical binning is available
BinningHorizontal	1	Horizontal binning is not available
	2	Horizontal binning is available

Note

To fasten the frame rate on binning, use the shutter in a sufficiently high speed.



Drive mode

“Mode 0” which prioritizes the frame rate is set by default.
The frame rate upper limit of “Mode 0” is higher than“Mode 1,” but the usable functions are limited.
When correcting the defects/shadings in “Mode 0.”
After detecting and saving the defects/shadings in “Mode 1,” return to “Mode 0” and use them.
Reboot the unit to reflect the changes of the drive mode.

command	parameter	Setting
DRIVE_MODE	0	Mode 0
	1	Mode 1

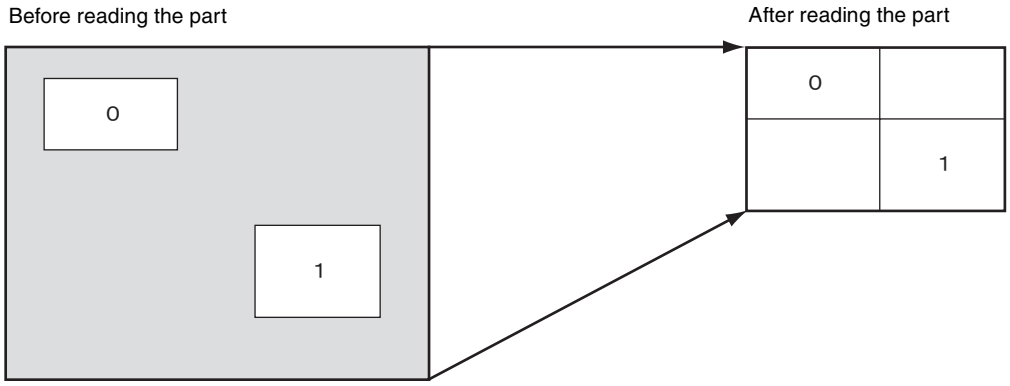
DRIVE_MODE	Mode 0	Mode 1
Maximum frame rate	75 fps (XCG-CG160/CG160C) 41 fps (XCG-CG240/CG240C) 23 fps (XCG-CG510/CG510C)	50 fps (XCG-CG160/CG160C) 32 fps (XCG-CG240/CG240C) 15 fps (XCG-CG510/CG510C)
Defect detection function	–	●
Defect correction function	●	●
Shading detection function	–	●
Shading correction function	●	●
Output format	See the “Output format” function.	
Free set sequence	●	–

● Usable function – Not usable function

Multi ROI (XCG-CG160/CG160C only)

You can set and read two arbitrary rectangular areas from the effective pixel area.
By reading only necessary parts, you can shorten the time it takes to read.

Register	Parameter	Setting
MultiROIMode	0 (Off)	All areas Off
	1 (On)	All areas On
	2	Highlight
MultiROISelect	0 to 1	Designates the number of the area the parameter is to be changed.
MultiROIEnable	0 (Off)	The area designated in MultiROISelect is Off.
	1 (On)	The area designated in MultiROISelect is On.
MultiROIWidth	4 to 1456	Horizontal size of the area
MultiROIHeight	4 to 1088	Vertical size of the area
MultiROIOffsetX	0 to 1452	Horizontal position of the area
MultiROIOffsetY	0 to 1084	Vertical position of the area



Output format

The settable pixel formats are as follows:

Register	Model	Drive mode	ReverseX/Y	Parameter	Setting
PixelFormat	XCG-CG240	Mode0	*	0x01080001	Mono8
			*	0x010C0004	Mono10Packed
		Mode1	*	0x01080001	Mono8
			*	0x010C0004	Mono10Packed
			*	0x010C0006	Mono12Packed
	XCG-CG240C	Mode0	0	0x0108000B	BayerBG8
			0	0x010C0029	BayerBG10Packed
		Mode1	0	0x0108000B	BayerBG8
			0	0x010C0029	BayerBG10Packed
			0	0x010C002D	BayerBG12Packed
		Mode0	1	0x01080008	BayerGR8
			1	0x010C0026	BayerGR10Packed
		Mode1	1	0x01080008	BayerGR8
			1	0x010C0026	BayerGR10Packed
			1	0x010C002A	BayerGR12Packed
		Mode0	2	0x0108000A	BayerGB8
			2	0x010C0028	BayerGB10Packed
		Mode1	2	0x0108000A	BayerGB8
			2	0x010C0028	BayerGB10Packed
			2	0x010C002C	BayerGB12Packed
		Mode0	3	0x01080009	BayerRG8
			3	0x010C0027	BayerRG10Packed
		Mode1	3	0x01080009	BayerRG8
			3	0x010C0027	BayerRG10Packed
			3	0x010C002B	BayerRG12Packed
			*	0x02180014	RGB8Packed
			*	0x02180015	BGR8Packed
			*	0x02180020	YUV8_UYV(YUV444)
			*	0x0210001F	YUV422_8_UYVY
			*	0x02100032	YUV422_8
	XCG-CG160/ CG510	Mode0	*	0x01080001	Mono8
		Mode1	*	0x01080001	Mono8
			*	0x010C0004	Mono10Packed
			*	0x010C0006	Mono12Packed

*: optional

* Selectable setting format varies between drive modes.

* Modes for ReverseX/Y are limited for the color camera, as some setting formats fix the pixel array.

Register	Model	Drive mode	ReverseX/Y	Parameter	Setting
PixelFormat	XCG-CG160C/ CG510C	Mode0	0	0x01080009	BayerRG8
		Mode1	0	0x01080009	BayerRG8
			0	0x010C0027	BayerRG10Packed
			0	0x010C002B	BayerRG12Packed
		Mode0	1	0x0108000A	BayerGB8
		Mode1	1	0x0108000A	BayerGB8
			1	0x010C0028	BayerGB10Packed
			1	0x010C002C	BayerGB12Packed
		Mode0	2	0x01080008	BayerGR8
		Mode1	2	0x01080008	BayerGR8
			2	0x010C0026	BayerGR10Packed
			2	0x010C002A	BayerGR12Packed
		Mode0	3	0x0108000B	BayerBG8
		Mode1	3	0x0108000B	BayerBG8
			3	0x010C0029	BayerBG10Packed
			3	0x010C002D	BayerBG12Packed
			*	0x02180014	RGB8Packed
			*	0x02180015	BGR8Packed
			*	0x02180020	YUV8_UYV(YUV444)
			*	0x0210001F	YUV422_8_UYVY
			*	0x02100032	YUV422_8

*: optional

Image flip (Same level as output format)

Flips an image vertically and horizontally.
Reboot the unit to reflect the changes of the setting.

Register	Parameter	Function
ReverseX/ ReverseY	0	Off (no flip)
	1	Flip vertically
	2	Flip horizontally
	3	Rotation of 180 degrees

Gain

Manual gain

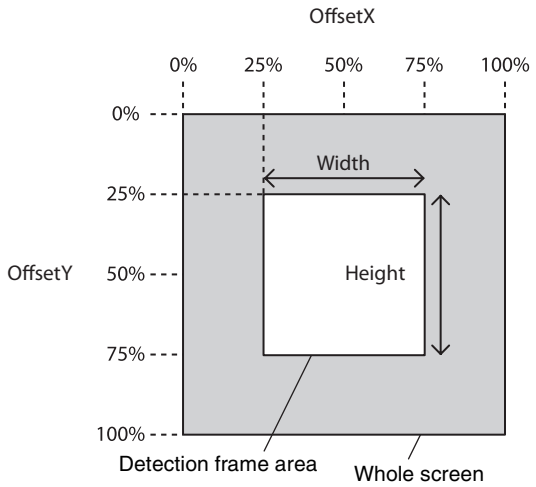
The manual gain can be finely set in 0.1 dB.
Although the settable lower/upper limit values of the gain are slightly different in each camera, the gain parameter value can be set from –1 dB or less to 27 dB or more. Same as the gain, the parameter value of the GainAnalogRaw can be set from –10 or less to 270 or more. The setting rage of the gain that guarantees image quality is from 0 dB to 18 dB.

Register	Parameter	Setting
Gain	–1 or less ~ 0 ~ 27 or more	Gain dB unit
GainAnalogRaw	–10 or less ~ 0 ~ 270 or more	Gain advanced setting

Auto gain (AGC)

By setting AUTOGAIN, the gain is automatically adjusted according to the image pickup environment. AGC works so that the average level in a detection frame may reach AGC-LEVEL. The AGC detection frame is set to the central region by default. The detection frame can be displayed or the detection area changed.

Register	Parameter	Setting
GainAutoMode	Off (0)	Manual gain
	Once (1)	One-push AGC
	Continuous (2)	Continuous AGC
GainAutoLevel	0 to 11264 to 16383	AGC target level (14 bits)
GainAuto-Speed	1 to 192 to 256	AGC convergence speed
GainAuto-UpperLimit	–10 or less ~ 180 ~ 270 or more	AGC upper limit
GainAuto-LowerLimit	–10 or less ~ 0 ~ 270 or more	AGC lower limit
DetectArea-GainAuto	Off (0)	AGC detection frame is hidden
	On (1)	AGC detection frame is displayed
DetectArea-GainAutoWidth	0 to 50 to 100	Width size of AGC detection frame
DetectAreaWB-AutoHeight	0 to 50 to 100	Height size of AGC detection frame
DetectAreaWB-AutoOffsetX	0 to 25 to 100	Horizontal position of AGC detection frame
DetectAreaWB-AutoOffsetY	0 to 25 to 100	Vertical position of AGC detection frame



Area gain

A separate digital gain can be set for a rectangular area of preference 16 positions.
If multiple rectangular areas are duplicated, the gain value of the low-numbered area takes priority.

Register	Parameter	Setting
AreaGainEnableAll	0 (Off)	Gains in all areas are set to Off
	1 (On)	Gains in all areas are set to On
AreaGainSelect	0 to 15	Specify the area number of the parameter to be changed.
AreaGainEnable	0 (Off)	Gains specified area in AreaGainSelect are set to Off
	1 (On)	Gains specified area in AreaGainSelect are set to On
AreaGainWidth	0 to Width	Horizontal size of area*
AreaGainHeight	0 to Height	Vertical size of area*
AreaGainOffsetX	OffsetX to Width	Horizontal position of area*
AreaGainOffsetY	OffsetY to Height	Vertical position of area*
AreaGainValue	0 to 256 (equal) to 8191	Gain value of area

* Specify the area size and position of the area gain on the absolute coordinate value for an effective pixel. Therefore, the range of the area size and position needs to be set within the readout range.

Shutter (Exposure)

Configuring the setting

The setting is configured in µs unit. With the default shutter value, the frame rate is maximized. During free run operation, the frame rate is reduced by setting a value bigger than the default shutter value. If you do not prioritize the image quality, you can set it up to 60 sec during operation. If the exposure time is long, it will be easier to see the pixel defects.

Note

Exposure time to be set varies depending on modes. Check the actual value with read out after completing settings.

Register	Parameter
ExposureTime	10*2 to 60000000

*2 The minimum value varies upon models or settings.

	Exposure Time [us]	Rate [fps]
XCG-CG160/ CG160C	12002	75
XCG-CG240/ CG240C	23300	41
XCG-CG510/ CG510C	42000	23

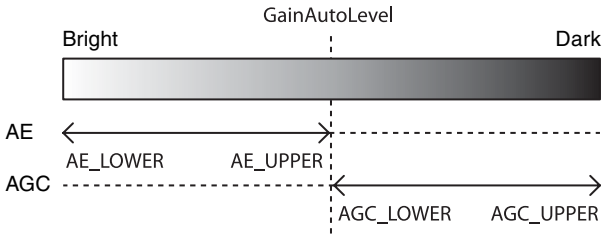
Auto exposure (AE)

The shutter is set automatically by detecting the output level. The target level is the same as the value of GainAutoLevel. This can be performed along with auto gain.

Register	Parameter	Setting
ExposureAutoMode	Off (0)	Manual shutter
	Once (1)	One-push AE
	Continuous (2)	Continuous AE
ExposureAuto-Speed	1 to 192 to 256	AE convergence speed
ExposureAuto-UpperLimit	1 to 2000000	AE upper limit
ExposureAuto-LowerLimit	1 to 2000000	AE lower limit

Combination of Continuous AGC and Continuous AE

AGC and AE coordinate with each other to adjust the level automatically with GainAutoLevel as the target level. When the environment starts getting dark and AE reaches the upper limit, AGC starts to work.



Trigger Control

Free run/trigger mode / PTP (IEEE1588)

Free run

The camera operates without a trigger signal and performs the video output operation continuously after the shutter (exposure) is finished. The horizontal and vertical timing signals are generated within the camera. During the free-run operation, image pickup timing cannot be controlled. In the free-run operation, the adjustment is made automatically to achieve the maximum frame rate according to the shutter setting.

Trigger mode

Exposure is started by detecting the externally input trigger signal. When ExposureMode is 0, exposure is started by detecting the rising or falling edge of the trigger signal and the trigger edge detection (exposure is performed based on the set shutter value) is performed. When ExposureMode is 1, the trigger width detection (exposed for the period of the trigger signal width) is performed.

Register	Parameter	Setting
TriggerMode	Off (0)	Free run
	On (1)	Trigger mode

Register	Parameter	Setting
TriggerSource	Line1 (0)	DC IN connector 2nd pin
	Line2 (1)	DC IN connector 3rd pin
	Line3 (2)	DC IN connector 4th pin*
	Software (4)	Software (TriggerSoftware register)
	FreeSetSequence (13)	FreeSetSequence mode
	PTP (15)	IEEE1588 sync mode

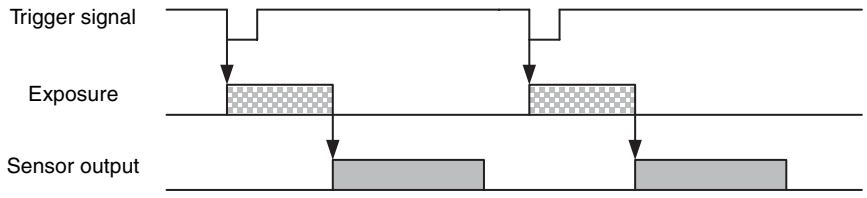
* XCG-CG160/CG160C: Unavailable. Dedicated to output.

For trigger mode (TriggerMode=On)

Register	Parameter	Setting
ExposureMode	Timed (0)	Trigger edge detection
	TriggerWidth (1)	Trigger width detection

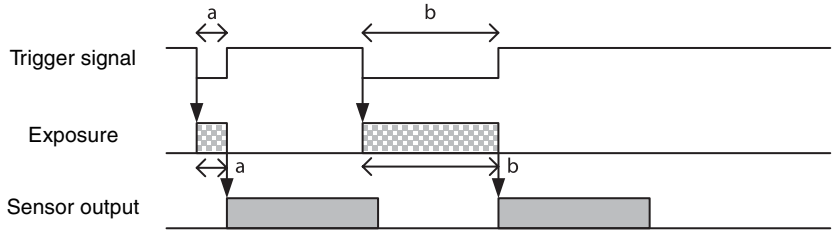
Trigger edge detection

The figure shows the trigger signal negative polarity (detecting the drop edge).



Trigger width detection

The figure shows the trigger signal negative polarity (detecting Low level width).



PTP (IEEE1588)

When running the unit in GigE Vision 2.0 mode, the unit can expose by synchronizing with a PTP (IEEE1588) server. This can work as a master or slave of PTP (Precision Time Protocol). Operate as a slave when you have a grand master device. When a grand master device is not available, you can make a single camera as a master and synchronize between cameras. You can set the current time on the camera which is treated as a master. If you don't set the time, the time the power was turned on would be 1/1/1970 0:00.

To use IEEE1588, you have to launch the camera in GigE Vision Version2.0 mode.

Register	Parameter	Setting
GevVersionForStartUp	GigE_Version_1_2	GigE Vision Version1.2
	GigE_Version_2_0	GigE Vision Version2.0

Restart the camera after you complete the settings.

Register	Parameter	Setting
GevIEEE1588	False	IEEE1588 OFF
	True	IEEE1588 ON
GevIEEE1588SlaveOnly	False	Becomes the master depending on the condition
	True	Works always as slave
GevIEEE1588Priority1	128	Priority 1
GevIEEE1588Priority2	128	Priority 2
GevIEEE1588DomainNumber	0	PTP domain designation
GevIEEE1588LogAnnounceInterval	Interval1s	Sending announce interval
GevIEEE1588LogSyncInterval	Interval1s	Sending Sync frame interval
GevIEEE1588LogMinDelayReqInterval	Interval1s	Minimum delay request interval
GevIEEE1588AnnounceReceiptTimeout	x3	Announce receiving timeout

You don't have to set these parameters in normal conditions.

The device to become the master will be determined automatically by the best master clock algorism.

Register	Parameter	Conditions
GevIEEE1588Status	Master	Master
	Slave	Slave

The camera is available for use when the status is either master or slave.

It takes around 10 sec. to start synchronizing from when the function is enabled.

Sync exposure using IEEE1588

When the timestamp on the camera is synchronized with the IEEE1588 master, the camera can start exposure by synchronizing with it.
On the firmware version 1.1.0 or later, if you set the trigger source to PTP, the camera starts synchronization only by setting the trigger interval. To synchronize with the camera of version 1.0.0, the synchronization start time should be set as well. The trigger interval can be set in 1ms units.

Register	Parameter	Setting
PTPTriggerInterval	Interval time	Trigger interval (ms)
PTPTriggerStartTime	Start time	Sync start time (sec.)

Sync start time is set by 32 bit values of seconds when time is represented by epoch time.

Time settings on Master

As the camera itself doesn't have a real-time clock, its internal watch starts working at the time the power is turned on as 1/1/1970 0:00. However, the current time can be set on the camera which works as the master for IEEE1588. The current time is 64 bit values of the epoch time represented by seconds multiplied by 1,000,000,000. Write this value on 2 registers in 32 bits each then perform settings with the time set command on the camera. This time setting is a simplified setting and there is no way to set the complete time on the camera. You can synchronize between cameras without setting the time of the master.
As the time is important when you use schedule action commands, we recommend setting the time on the master.

Register	Parameter	Setting
PTPMasterTimeInitialValueHigh	Time	Upper 32 bits
PTPMasterTimeInitialValueLow	Time	Lower 32 bits
PTPSoftwareTriggerTimeSet	-	Time set command

Starting exposure with the set time synched with IEEE1588

You can start exposure by setting the absolute time.
Only 1 time can be registered. The next exposure can be reserved when the exposure starts.
As with the setting of the IEEE1588 master time, the time is reserved by writing the epoch time expressed in seconds and multiplying it by 1,000,000,000 (64 bits) into two 32 bit registers and sending the time set command. If the past time has been passed, the exposure starts immediately.

Register	Parameter	Setting
PTPSoftwareTriggerTimeHigh	Time	Upper 32 bits
PTPSoftwareTriggerTimeLow	Time	Lower 32 bits
PTPSoftwareTriggerTimeSet	-	Time set command

GPO output with setting time synched with IEEE1588

You can output the signal to the GPO connector by setting the absolute time.
1 time can be registered. The next output can be reserved when the signal is output.
As with the setting of the IEEE1588 master time, the time is reserved by writing the epoch time expressed in seconds and multiplying it by 1,000,000,000 (64 bits) into two 32 bit registers and sending the time set command. If the past time has been passed, the exposure starts immediately.

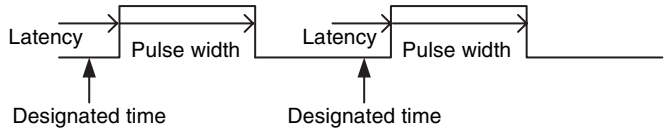
Register	Parameter	Setting
PTPSoftwareTriggerTimeHigh	Time	Upper 32 bits
PTPSoftwareTriggerTimeLow	Time	Lower 32 bits
PTPSoftwareTriggerTimeSet	-	Time set command

The signal flips the current condition.

Latency and pulse width from the specified time can be set. Specifying the pulse width to 0 maintains the condition. When the pulse width is set to 0, the signal flips over each time you execute the command. Please keep in mind that if the next command time comes earlier than the set pulse width, the signal flips over.

Register	Parameter	Setting
ActionCommandPulseDelayLine2	Latency time	Line2 latency time
ActionCommandPulseWidthLine2	Pulse width	Line2 pulse width
ActionCommandPulseDelayLine3	Latency time	Line3 latency time
ActionCommandPulseWidthLine3	Pulse width	Line3 pulse time

When the pulse width is a value other than 0



When the pulse width is a value 0

Special trigger

When operating in trigger mode and performing image pickup in different conditions (such as the shutter, gain, and image pickup area), the setting has to be changed in advance for each trigger input. However, if the special trigger operation is enabled, the setting does not have to be changed and continuous image pick up in different conditions is facilitated. Up to 16 settings can be configured. There are the bulk operations in which images are taken consecutively by inputting the trigger signal once and the sequential operation in which images are taken each time the trigger signal is detected. The next exposure is started after the end of video output. In the sequential operation, the second and subsequent trigger signals should be input 5 ms or more after the end of video output. The special trigger operation and trigger mode operation cannot be enabled at the same time. The source and polarity of the special trigger signal should be defined separately from the trigger mode. Each setting should be saved in the user set. For the items reflected, refer to “Command List” (page 47).

Register	Parameter	Setting
SpecialTriggerMode	Off (0)	Special trigger off
	Bulk (1)	Bulk trigger
	Sequential (2)	Sequential trigger

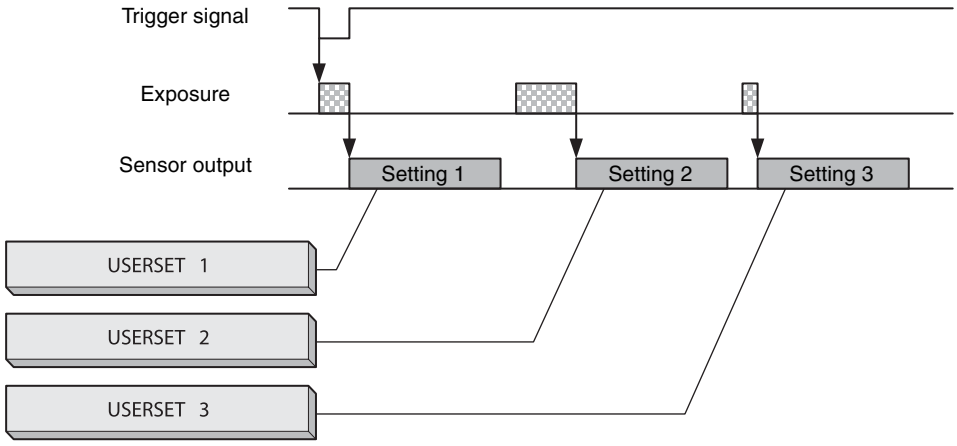
Register	Parameter	Setting
SpecialTriggerSource	Line1 (0)	DC IN connector 2nd pin
	Line2 (1)	DC IN connector 3rd pin*
	Line3 (2)	DC IN connector 4th pin*
	Software (4)	Software command

* XCG-CG160/CG160C: Unavailable. Dedicated to output.

Register	Parameter	Setting
SpecialTriggerActivation	FallingEdge (0)	Negative
	RisingEdge (1)	Positive
NumberOfMemoryForSpecialTriggerMode	1 to 2 to 16	Number of shot images during the bulk operation

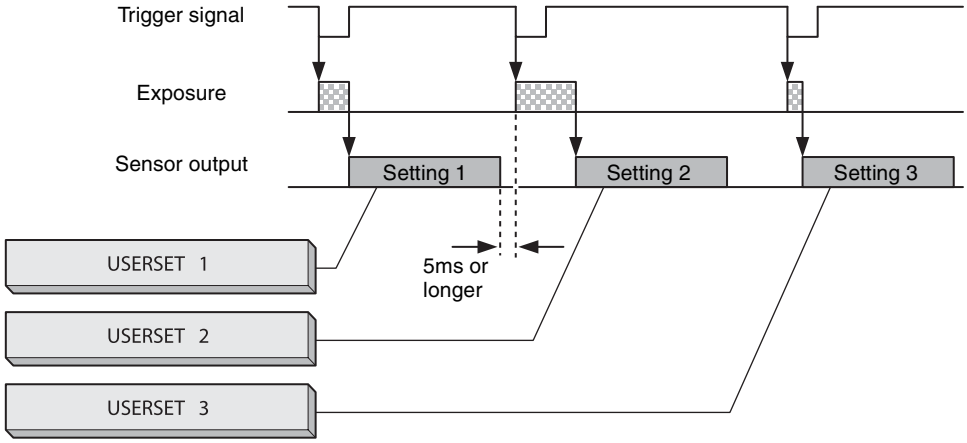
Bulk

SpecialTriggerSource=1, SpecialTriggerActivation=0, NumberOfMemoryForSpecialTriggerMode=3 in the figure.



Sequential

SpecialTriggerMode=2, SpecialTriggerActivation=0 in the figure.



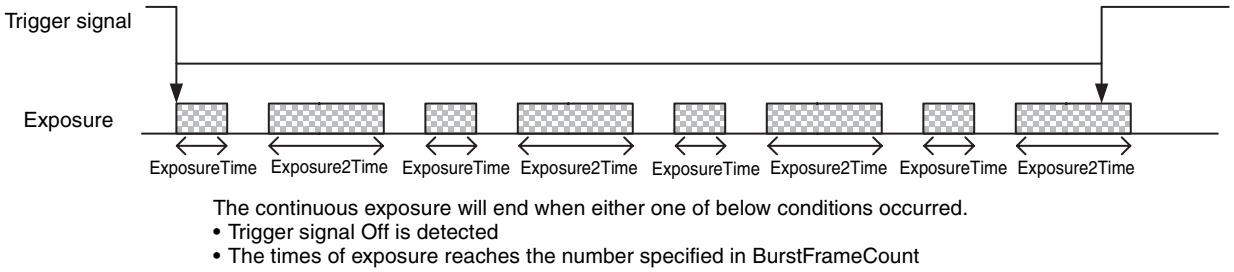
Burst trigger

Exposure can be repeated with a single trigger signal. Two modes are available; a mode that repeats a single exposure time and a mode that alternately repeats two exposure times.

Register	Parameter	Setting	
BurstMode	Off(0)		
	SingleExposureTime(1)	Upon trigger edge detection	Exposes for the period set in ExposureTime.
		Upon trigger width detection	Exposes for the range of trigger width.
	DualExposureTime(2)	Upon trigger edge detection	Exposes for periods set in ExposureTime and ExposureTime2 alternatively.
		Upon trigger width detection	Exposes for periods in trigger width and trigger width x Exposure2Ratio alternately.
BurstPeriod	FrameCount(0)	Exposes only the times set in BurstFrameCount.	
	TriggerDuration(1)	Performs burst exposure while the input trigger is on. However, burst exposure would be terminated when it reaches BurstFrameCount. Enabled when ExposureMode is in edge detection mode. Disabled in width detection mode.	
BurstFrameCount	0 to 65533	0: repeated unlimitedly	
		1 or more: exposure for designated times	
BurstForceStop	1	Forced termination of repeated exposure	
Exposure2Time	1 to 60000000	Second exposure time during trigger edge detection	
Exposure2Ratio	1, 2, 4, 8, 16	Value to determine the second exposure time of trigger width detection. The first exposure time (trigger width) multiplied by this value is the second exposure time.	

Trigger edge detection (ExposureMode = Timed(0))

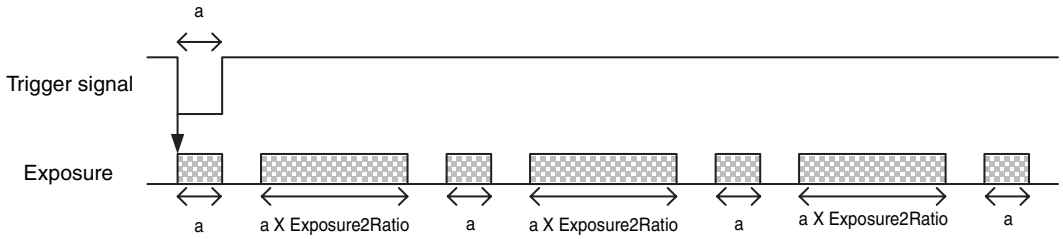
BurstPeriod = TriggerDuration(1)
BurstMode = DualExposureTime(2)



The continuous exposure will end when either one of below conditions occurred.
- Trigger signal Off is detected
- The times of exposure reaches the number specified in BurstFrameCount

Trigger width detection (ExposureMode = TriggerWidth(1))

BurstFrameCount = 7
BurstMode = DualExposureTime(2)

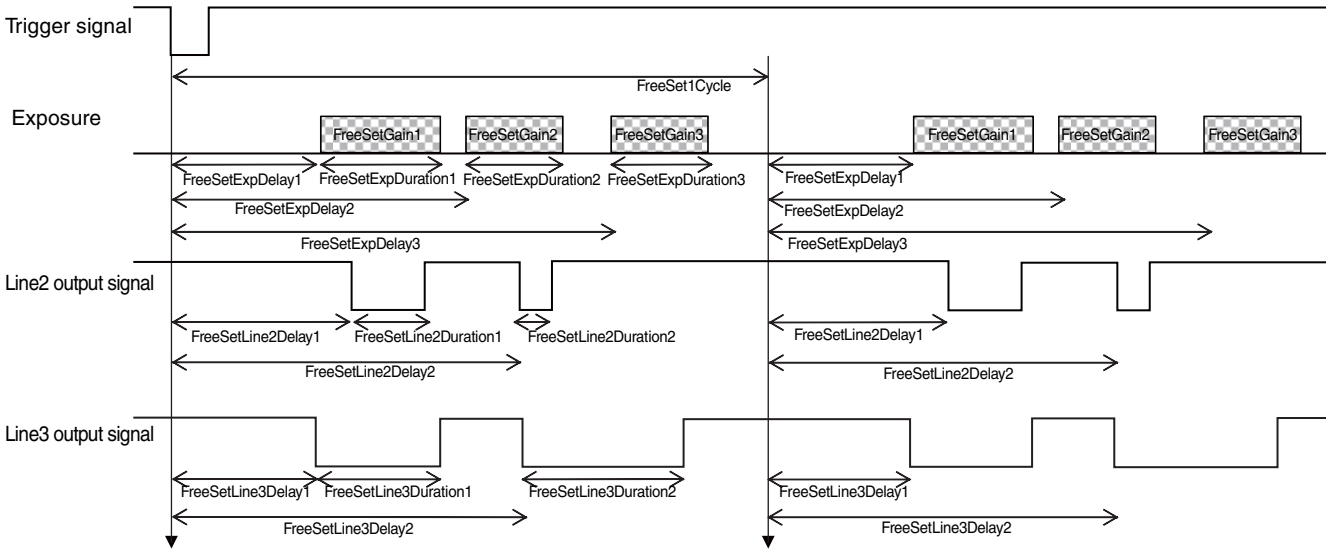


FreeSetSequence

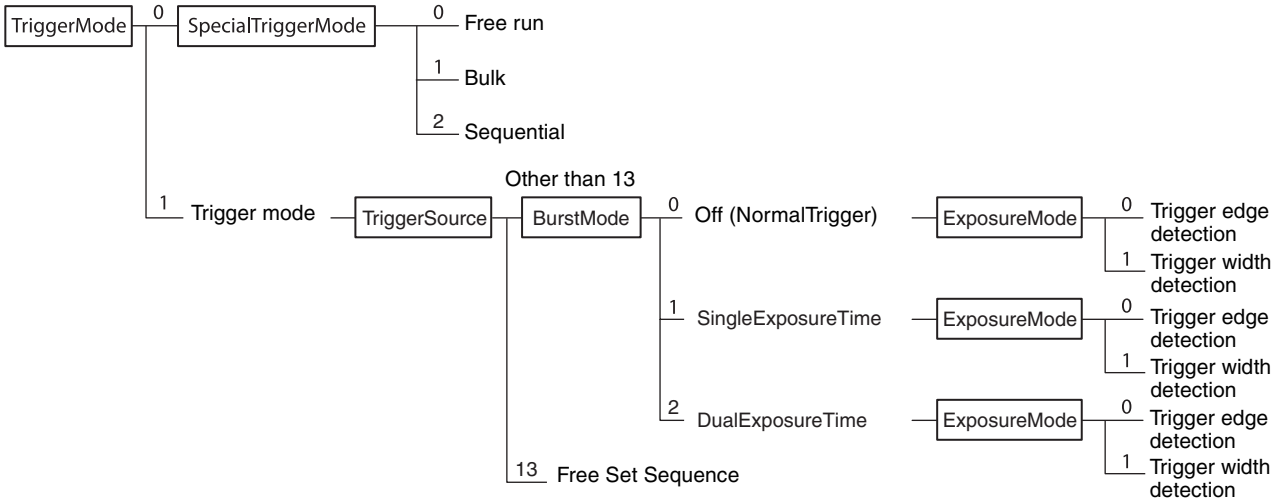
Multiple exposure and GPO output can be performed with a single trigger signal. The start time, length and gain of exposure, and GPO output can be set arbitrarily. However, do not set the start time and length so that there is inversion/ overlap of the order. It is also possible to repeat the cycle with a set of exposure and GPO output set as one cycle.

Register	Parameter	Setting
FreeSetTriggerSource	Line1(0)	DC IN connector #2 pin
	Line2(1)	DC IN connector #3 pin
	Line3(2)	DC IN connector #4 pin*
	Software(4)	Software (TriggerSoftware register)
	PTP(15)	IEEE1588 sync mode
FreeSetStop	1	Forced end of FreeSetSequence
FreeSet1Cycle	1 to 10000000	Designate the length of 1 cycle of FreeSetSequence in µSec.
FreeSet1CycleNum	0 to 65533	Designate how many cycles to run FreeSetSequence. No repetition when this is 0.
FreeSetSelect	1 to 10	Designate which action parameter for which number to display/change.
FreeSetLine2Delay	-1 to 10000000	Designate the Line2 GPO exposure start time (µSec). No output is performed in -1.
FreeSetLine2Duration	0 to 10000000	Designate the Line2 GPO output length (µSec).
FreeSetLine3Delay	-1 to 10000000	Designate the Line3 GPO exposure start time (µSec). No output is performed in -1.
FreeSetLine3Duration	0 to 10000000	Designate the Line3 GPO output length (µSec).
FreeSetExpDelay	-1 to 10000000	Designate the exposure start time (µSec). No output is performed in -1.
FreeSetExpDuration	0 to 10000000	Designate the exposure start time (µSec).
FreeSetGain	Same as GainAnalogRaw	Designate the advanced gain settings of exposure (GainAnalogRaw relevance).
FreeSetSave	1	Save the settings of FreeSetSequence.
FreeSetLoad	1	Readout the settings of FreeSetSequence.

* XCG-CG160/C160C: Unavailable. Dedicated to output.



Trigger states



Trigger source

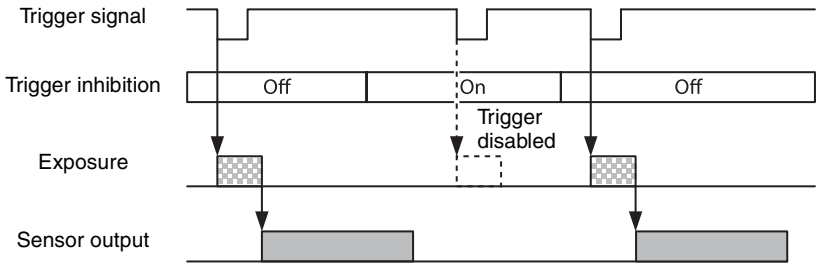
This can be input via the DC IN connector or software command (TriggerSoftware). Refer to “Trigger Signal Input” (page 12) for details.

Notes

- The trigger sources when operating the special trigger and the trigger mode are separately defined.
- The PTP cannot be selected in the special trigger mode.

Trigger inhibition

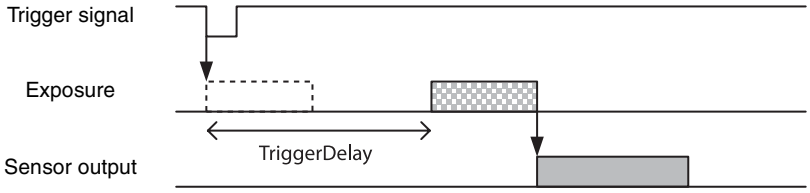
Trigger input can be disabled. This function is effective when disabling the trigger signal to a specific camera in the environment where multiple cameras are connected by the same trigger signal and when preventing false operations caused by noise contamination to the trigger signal line (due to the installed environment).



Register	Parameter	Setting
TriggerInhibit	Off (0)	Trigger is accepted
	On (1)	Trigger is not accepted

Trigger delay

The camera can delay the trigger signal.



Register	Parameter	Setting
TriggerDelay	0 to 4000000	Trigger delay [µs]

Trigger counter

Accepted triggers by which video output is performed are counted. Triggers are counted up by the internal counter even in the free-run operation. Setting 0 resets the counter. Video output is not performed for triggers that coincide with the double exposure timing, but triggers are counted up. Triggers that have been removed by trigger range limit are not counted. The trigger counter returns to 0 when the upper limit (2147483647) is reached. The trigger counter can return to 0 by writing 1 to the TriggerCounterReset register.

Register
TriggerCounter
TriggerCounterReset

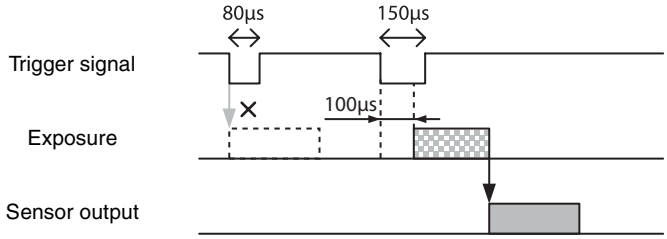
Trigger range limit

Only signals in the set trigger width can be accepted as the trigger signal. This functions as a noise filter, which removes chattering or disturbance noise in the trigger signal line. When the trigger signal is input, exposure is started with the time lag of the trigger range setting values. Image will not be output, when trigger signal width is out of set range.

Register	Parameter	Setting
TriggerAcceptanceRangeEnabled	Off (0)	Trigger range off
	On (1)	Trigger range on
TriggerAcceptanceRangeLowerLimit	1 to 2000000	Trigger range lower limit [µs]

Trigger range operation example

ExposureTime=300, TriggerAcceptanceRangeLowerLimit=100 in the figure.



Frame Rate

Auto frame rate

The reading cycle is set to allow the frame rate to be the maximum value automatically according to the current shutter setting and the partial scan setting in the free-run operation (Shutter has priority). The next exposure is performed while outputting a video and the next video output is started immediately after finishing all video outputs. The frame rate is lowered when setting the shutter time longer than the video output time.

Register	Parameter	Setting
AcquisitionFrameRateAuto	Off (0)	Auto frame rate off
	On (1)	Auto frame rate on

Specifying frame rate

The frame rate of the video output can be specified in the free-run operation. The value of the frame rate [fps] should be entered. The frame rate faster than the fastest frame rate cannot be set.

Register	Parameter	Setting
AcquisitionFrameRate	0.0625 to 2000	Frame rate [fps]

* The upper limit varies depending on the partial scan setting.

Displaying frame rate

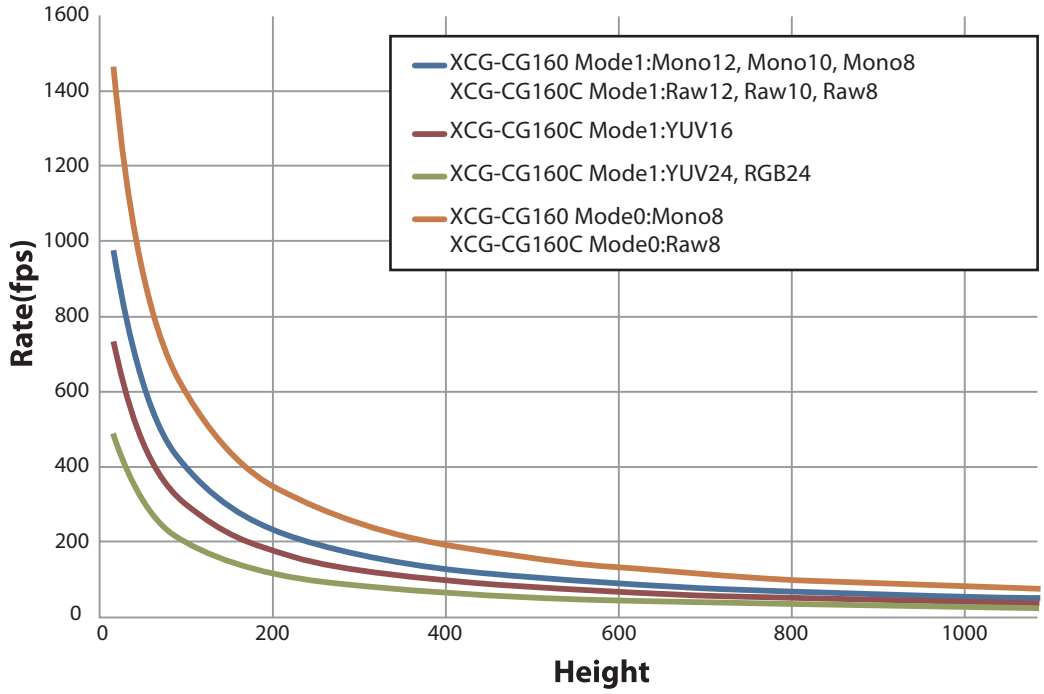
The current frame rate during the auto frame rate operation is displayed.

Register
AcquisitionFrameRateActual

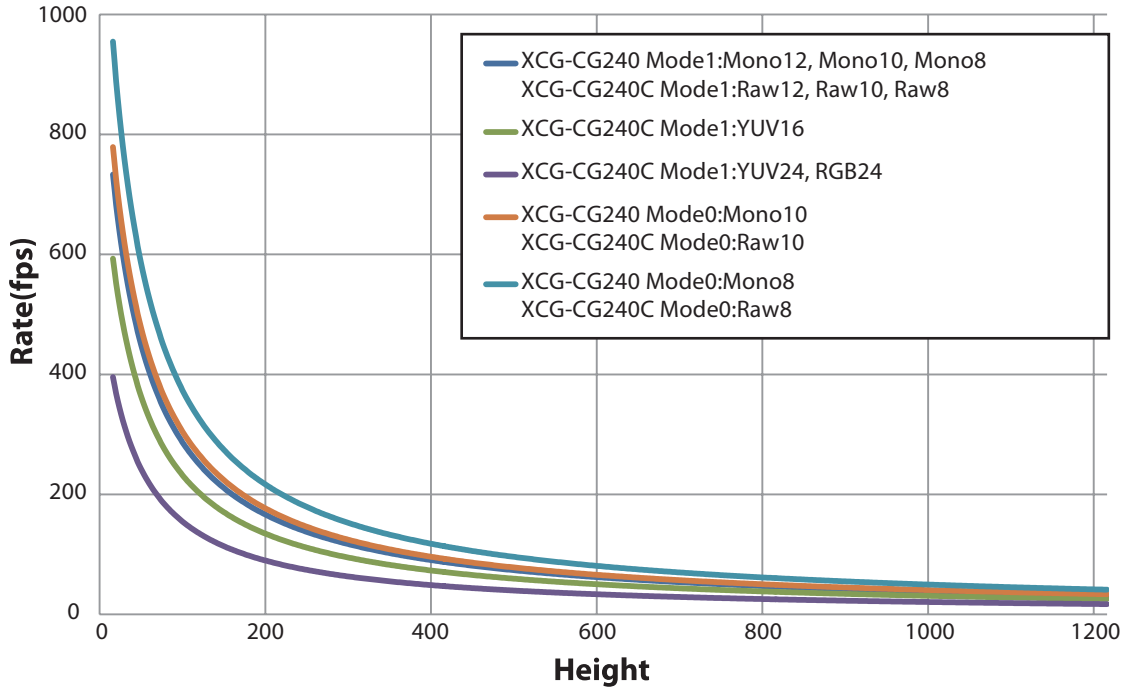
Fastest frame rate for partial scanning

The fastest frame rate varies depending on Height for partial scanning.

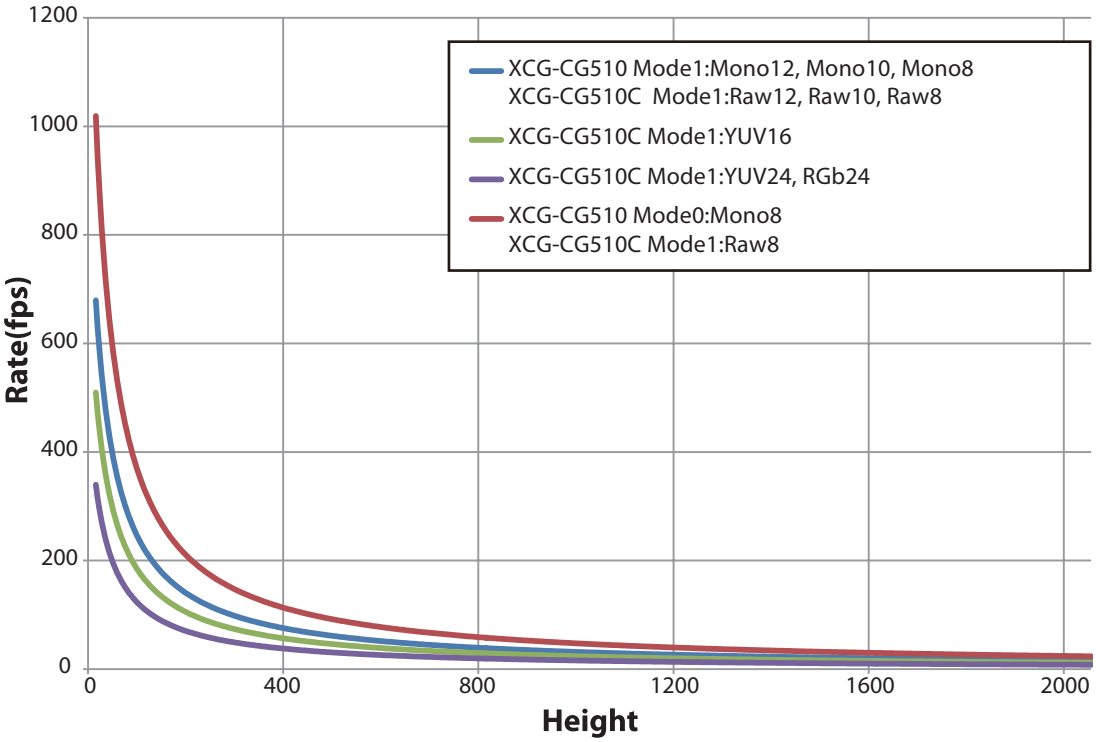
XCG-CG160/CG160C



XCG-CG240/CG240C



XCG-CG510/CG510C



Frame counter

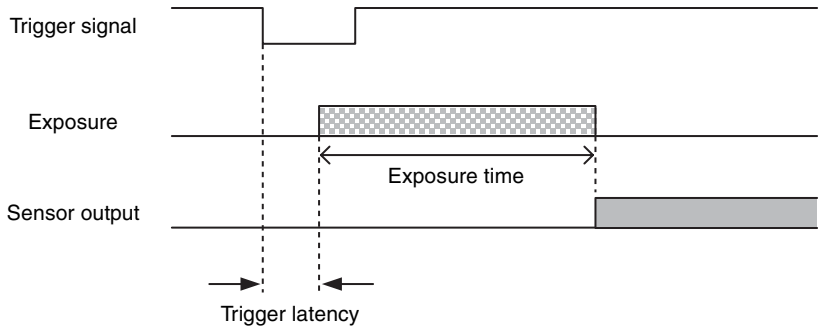
Reads out the number of frames output.
The counter can be reset.

Register
FrameCounter
FrameCounterReset

Timing Chart

Trigger latency/Exposure time

The values of trigger latency (time from the trigger acceptance to the exposure start) are as follows.



XCG-CG160/CG160C
XCG-CG510/CG510C

Register	Parameter	Trigger latency	Exposure time
FastTriggerMode	On (0)	approx. 0.2 µs	ExposureTime ± (approx. 0 µs to approx. 13 µs)
	Off (1)	approx. 11 µs to approx. 107 µs (XCG-CG160/CG160C)	ExposureTime ± (approx. 0 µs to approx. 36 µs) (XCG-CG160/CG160C)
		approx. 41 µs to approx. 184 µs (XCG-CG510/CG510C)	ExposureTime ± (approx. 0 µs to approx. 62 µs) (XCG-CG510/CG510C)

* Setting on overlap trigger prohibited. Variation in trigger latency and exposure time varies depending on output mode settings.

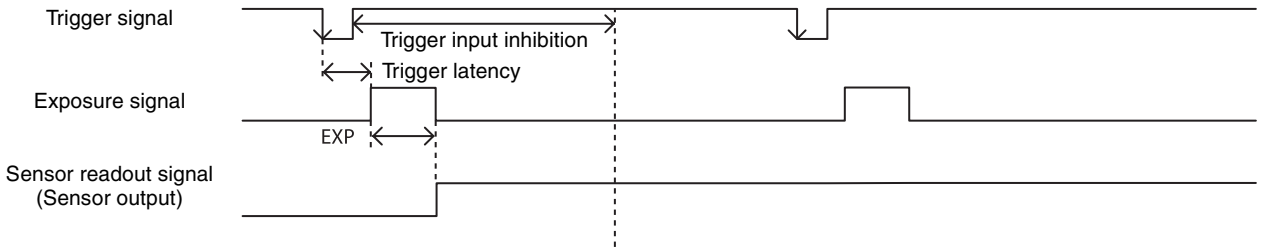
XCG-CG240/CG240C

Trigger latency	Exposure time
approx. 40 µs to approx. 140 µs	ExposureTime ± (approx. 0 µs to approx. 47 µs)

* Setting on overlap trigger prohibited. Variation in trigger latency and exposure time varies depending on output mode settings.

Trigger Overlap

The trigger signals can be accepted during the sensor readout signals are asserted.
If the trigger cycle overs the maximum value of the frame rate, images are distorted.
Set FastTriggerMode to OFF for XCG-CG160/CG160C and XCG-CG510/CG510C.



Memory shot

Memory shot is a function that controls the exposure timing and image output to the network individually. This is effective when multiple cameras are connected to the same network and it is necessary to expose them at the same time in a configuration that exceeds 1 Gbps band when operated simultaneously.
Memory shot is available in multi-frame mode or single-frame mode.
Number of images that can be saved is determined by image size and pixel format.

How to use:

Set the image size and pixel format. Turn on the memory shot mode in AcquisitionStop status.
Designate the number of images to record in AcquisitionFrameCount. The maximum number that can be stored can be obtained as the max value of AcquisitionFrameCount in GenICam API.
When you execute AcquisitionStart, the exposure starts immediately and the image data is stored in the internal memory when the trigger is in the OFF state. Recording will be finished when the number of images meets the designated number. At this time, the recording completion notification is sent to the application with Event(ID=0xB000).
The image is output when the output start command is sent.

Register	Parameter	Setting
MemoryShotMode	Off	Memory shot mode OFF
	On	Memory shot mode ON
MemoryShotImageOutputStart	-	Image output starts

Sequence when exposing three shots in free run

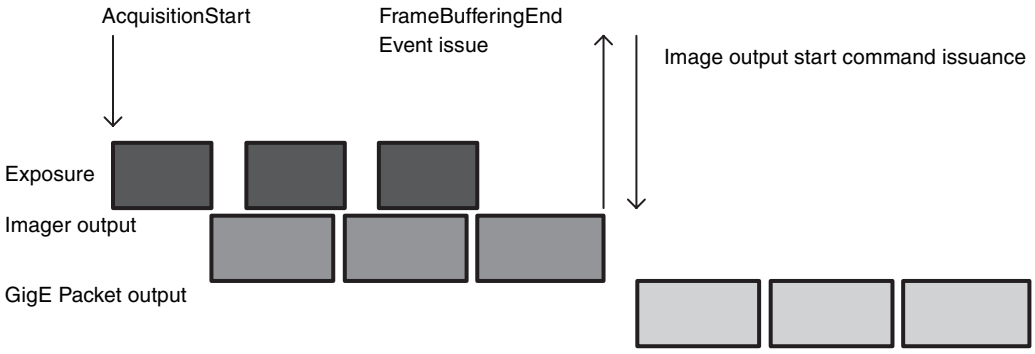
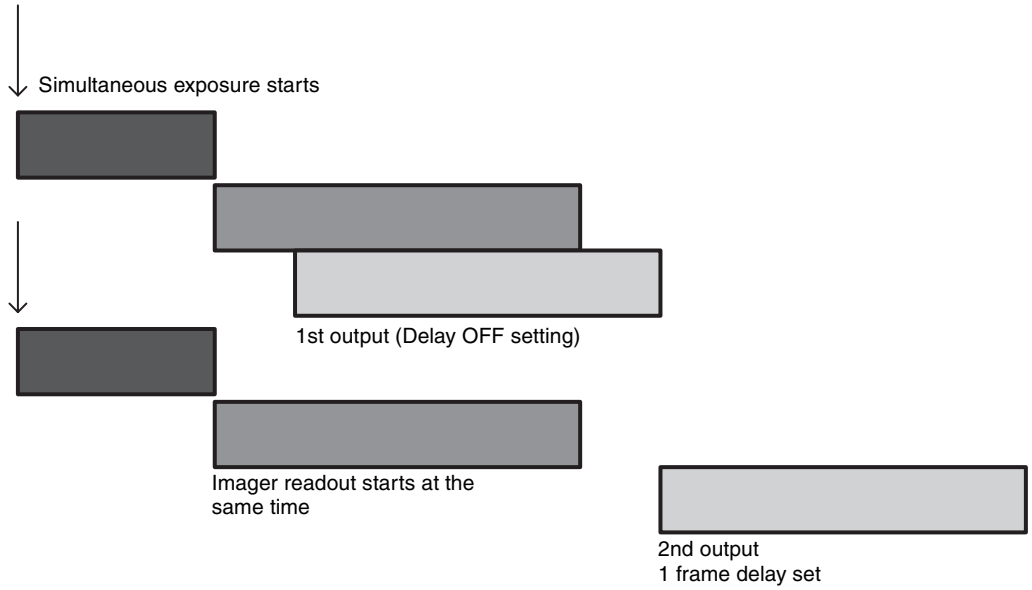


Image delay output

Normally, images are sequentially output when the exposure is completed. However, the timing of output start can be delayed. This is effective when multiple cameras are connected to the same network and it is necessary to expose at the same time in a configuration that exceeds 1 Gbps band when operated simultaneously.
Use in normal trigger mode when you use delay output. When you perform exposure for 2 cameras at the same time, set no delay on the first camera and set the time of completion of image output on the first camera to the second camera.

Register	Parameter	Setting
ImageTransferDelayMode	0	Delay mode OFF
	1	Delay mode ON
ImageTransferDelayValue	0 to 10000	Up to 10 seconds (ms)



Broadcast support of command

As normal commands are executed by unicast communication, you cannot perform the same command at the same time on multiple cameras. This camera is equipped with the function that receives the command sent to the broadcast. As the GigE Vision standard does not recommend sending commands destined for broadcasts, broadcast reception is disabled by default.

Register	Parameter	Setting
BroadcastWriteRegEnable	Disable	Ignore the commands sent to the broadcast
	Enable	Execute the commands sent to the broadcast

White Balance

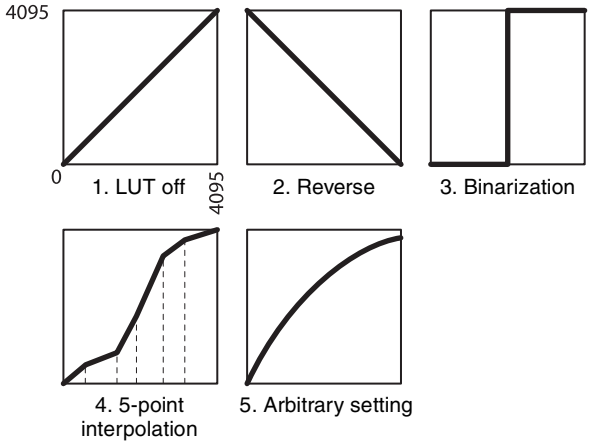
The white balance can be automatically adjusted when the BalanceWhiteAuto command is executed. The detection area is set to the screen center by default. The detection area can also be displayed on the screen. The detection frame can be changed arbitrarily (DetectAreaWBAuto). For manual correction, the GainDigital should be changed.

Register	Parameter	Setting
BalanceWhiteAuto	Off (0)	Manual correction
	Once (1)	One-push AWB
	Continuous (2)	Continuous AWB
DetectAreaGainAuto	Off (0)	Detection frame is hidden
	On (1)	Detection frame is displayed
GainDigitalRedRaw	256 (x1) to 4096	Red gain
GainDigitalGreenRaw	256 (x1) to 4096	Green gain
GainDigitalBlueRaw	256 (x1) to 4096	Blue gain

LUT

Five types of presets are provided. Specify using a 12 bit value. Binarization, 5-point interpolation, and arbitrary setting can be changed.

Register	Parameter	Setting
LUTEnable	Off (0)	LUT off (γ=1)
	On (1)	LUT on
LUTFormat	Linear (0)	Linear (γ=1)
	Reverse (1)	Reverse
	Binarization (2)	Binarization
	LinearInterpolation (3)	5-point interpolation
	UserSet (4)	Arbitrary setting



Binarization

The binarization threshold can be changed.

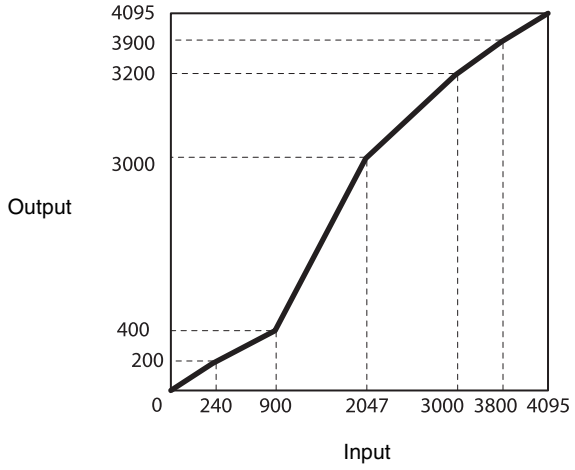
Register	Parameter
BinarizationThreshold	0 to 2047 to 4096

5-point interpolation

The values of output points 1 through 5 that correspond to input points 1 through 5 can be changed. Linear interpolation is performed between interpolation points.

Register	Parameter	Setting
LinearInterpolation-Index	1 to 5	Select the interpolation points
LinearInterpolation-InValue	0 to 4095	Input
LinearInterpolation-OutValue	0 to 4095	Output
LinearInterpolation-Build		Build LUT

Setting example:



LinearInterpolationIndex = 1
LinearInterpolationInValue = 240
LinearInterpolationOutValue = 200
LinearInterpolationIndex = 2
LinearInterpolationInValue = 900
LinearInterpolationOutValue = 400
LinearInterpolationIndex = 3
LinearInterpolationInValue = 2047
LinearInterpolationOutValue = 3000
LinearInterpolationIndex = 4
LinearInterpolationInValue = 3000
LinearInterpolationOutValue = 3200
LinearInterpolationIndex = 5
LinearInterpolationInValue = 3800
LinearInterpolationOutValue = 3900
LinearInterpolationBuild

Arbitrary setting

The output values 0 through 4095 that correspond to input values 0 through 4095 can be changed.

Register	Parameter	Setting
LUTIndex	0 to 4095	Input
LUTValue	0 to 4095	Output

Setting example:

LUTIndex = 0
LUTValue = 3
LUTIndex = 1
LUTValue = 10
…
LUTIndex = 4094
LUTValue = 4000
LUTIndex = 4095
LUTValue = 4010

Save LUT

When you change the settings, save them using the LUTSAVE command.

Register	Parameter	Setting
LUTValueSave		Save LUT

Color Matrix Conversion

During RGB 24-bit, YUV 24-bit, and YUV 16-bit output, the following color matrix conversion can be applied to the color model. Specify using values between –8191 and +8191. 256 is ×1.

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} Gain00 & Gain01 & Gain02 \\ Gain10 & Gain11 & Gain12 \\ Gain20 & Gain21 & Gain22 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Register	Parameter	Setting
ColorMatrixEnable	On (0)	Conversion off
	Off (1)	Conversion on

Register	Parameter	Setting
ColorMatrixSelector-Row	0 to 2	Matrix row position
ColorMatrixSelector-Column	0 to 2	Matrix column position
ColorMatrixValue	–8191 to 8191	Gain value

3 × 3 filter

Monochrome model and color model apply a 3 × 3 area filter for RAW output. The brightness of the central pixel and the eight pixels around it, and the parameter of each pixel are multiplied and added together, The result is the brightness of the central pixels. Specify using values between -8191 and 8191. The parameter 256 is ×1. Depending on the patterns of parameters, you can reduce noise, apply edge enhancement and extract the contour.

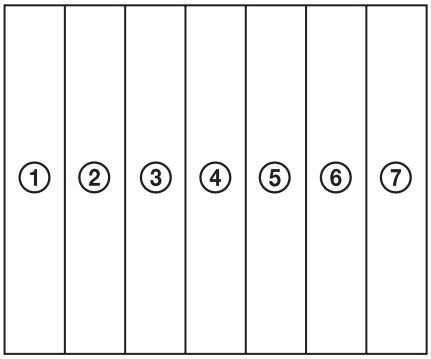
Register	Parameter	Setting
SpatialFilterEnable	Off (0)	Filter off
	On (1)	Filter on

Register	Parameter	Setting
SpatialFilterSelector-Row	0 to 2	Matrix row position
SpatialFilterSelector-Column	0 to 2	Matrix column position
SpatialFilterValue	−8191 to 8191	Filter parameters

Test Chart Output

For monochrome model, monochrome chart can be set. For color model, monochrome chart or color chart can be set.

Register	Parameter	Setting
TestImageSelector	Off (0)	Off
	GrayBar (1)	Monochrome chart
	ColorBar (3)	Color chart



	Monochrome	Color		
	Raw/Mono	R	G	B
(1)	0xF30	0x3FF	0x3FF	0x3FF
(2)	0xDC0	0x3FF	0x3FF	0
(3)	0xC80	0	0x3FF	0x3FF
(4)	0xA00	0	0x3FF	0
(5)	0x7A0	0x3FF	0	0x3FF
(6)	0x550	0x3FF	0	0
(7)	0x340	0	0	0x3FF

* 12 bit notation

GPIO

GPI

The signal level which is input in the 2nd, 3rd, and 4th* DC IN connector can be detected. After selecting a connector by LineSelector register, the signal level is acquired from LineStatus register.

* Only output is available for XCG-CG160/CG160C

GPO

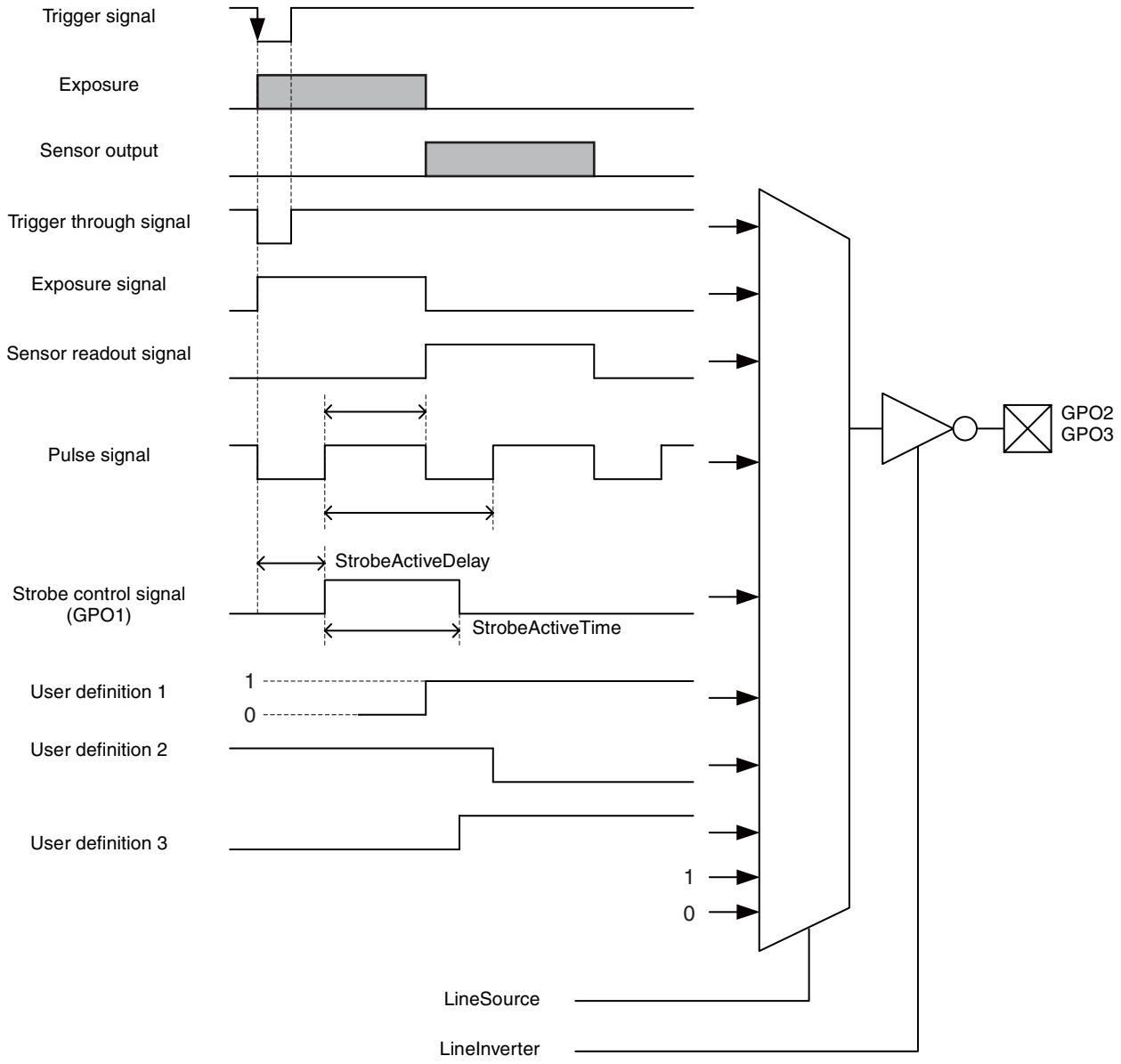
Various signals can be output from the 3rd and 4th DC IN connector. After selecting a connector by LineSelector register and setting LineMode to Output, LineSource is set. The output polarity is set by LineInverter register.

Register	Parameter	Setting
LineSelector	Line1 (0)	DC IN connector 2nd pin
	Line2 (1)	DC IN connector 3rd pin
	Line3 (2)	DC IN connector 4th pin
LineMode	Input (0)	Set to input
	Output (1)	Set to output
LineInverter	Off (0)	Without output inversion
	On (1)	With output inversion
LineStatus		Input signal level
LineSource	TriggerThrough (0)	Trigger through signal
	ExposureActive (1)	Exposure signal
	StrobeActive (2)	Strobe control signal
	SensorReadout (3)	Sensor readout signal
	UserOutput1 (4)	User definition 1
	UserOutput2 (5)	User definition 2
	UserOutput3 (6)	User definition 3
	SignalTrue (7)	Level H
	SignalFalse (8)	Level L
	PWM (9)	Pulse generation signal
	ActionCommandPulse (10)	Action command signal
	FreeSetSequence (11)	Free set sequence signal

Setting example:

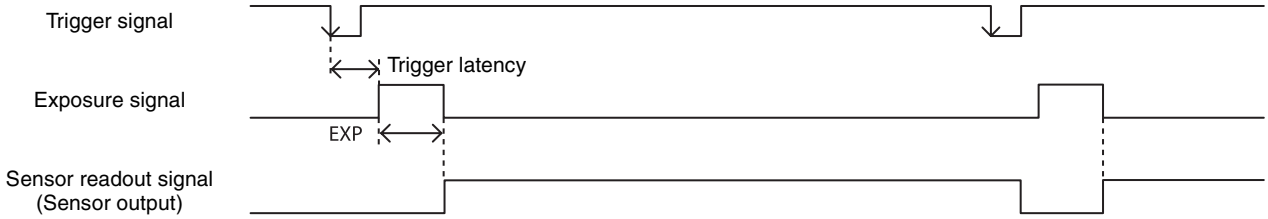
The strobe control signal is output to GPO2 (DC IN connector 3rd pin) by Hi active setting.
LineSelector = 1
LineMode = 1
LineInverter = 0
LineSource = 2

GPO output system diagram (example of GPO1)



Sensor Readout (Sensor Output)

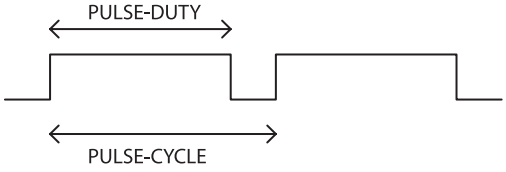
This signal indicates that exposure has completed and the image sensor has entered the video output sequence (enabled only when operating the trigger mode). Output is available from the GPO2/3 terminals. The sensor readout signal is asserted before optical black (OB) and the effective pixel area is output. Image might not be output properly, if trigger signal is input while this signal is asserted.



Pulse Train Generator

Pulse waveforms can be output from the GPO2/3 connector. Available range is 0.5Hz to 100kHz.

Register	Parameter
PWMPulseDutyT	1 to 2000000 [µs]
PWMPulseCycleT	10 to 2000000 [µs]



Status LED

The LED-on, blinking, or LED-off condition of the LED on the rear panel is as follows:

LED-on	Power is turned on and an IP address is set.
Blinking (low speed)	Power is turned on and an IP address is not set.
Blinking (high speed)	Power is turned on and the reset button is pressed down.
LED-off	Power is turned off or during startup. Or LED-off by a user command.

Temperature Readout Function

The camera's internal temperature can be read from the temperature sensor installed in the circuit board. Its accuracy is ±2°C. Use this value as a general guide.
If the interval of the temperature sensor value is set to a value other than 0, the temperature information can be transmitted to a PC application as an event data.

Register	Parameter	Setting
CameraTemperature		Temperature sensor value
CameraTemperature-MeasurementInterval	32-bit integers	Update interval of the temperature sensor value [second]

Defect Correction

This function corrects clear defect points and opaque defect points. From the peripheral pixels, correction is performed on coordinate pixels in which defects are detected. The factory setting and user setting can be selected.

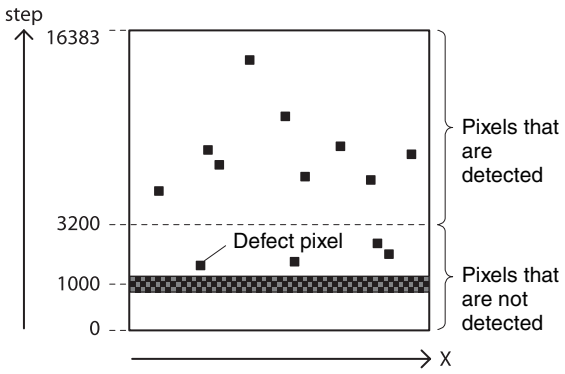
Register	Parameter	Setting
DefectCorrection	Off(0)	Correction off
	On(1)	Correction on

Defect correction setup procedure

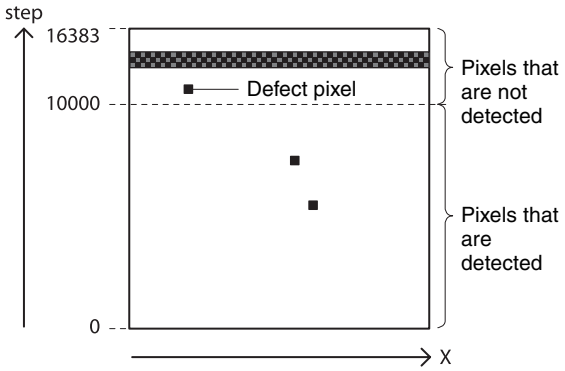
1 Set conditions in which clear defect points are prone to occur. Below is an example in which gain is 18 dB and the shutter is 1 second. Prevent as much light as possible from entering such as by blocking light.
>Gain=180
>ExposureTime=1000000

2 Set the threshold in units of 14 bits. Points are detected as clear defect points when this level is exceeded. Below is an example for 3200 step/14bit. Pixels that indicate 3200 to 16383 are detected.
>DefectThreshold=3200

3 Execute clear defect point detection. Detection takes four times the EXP time setting. The output levels on the same x coordinate axis are shown below. The levels uniformly indicate around 1000 steps when an all-black image is taken, but defect pixels (at high levels) are present in some locations. All pixels whose levels exceed 3200 steps, which was set in step 2, are detected.
Execute the detection after the image transfer is set to off.
>AcquisitionStop
>DefectDetectionMode=1



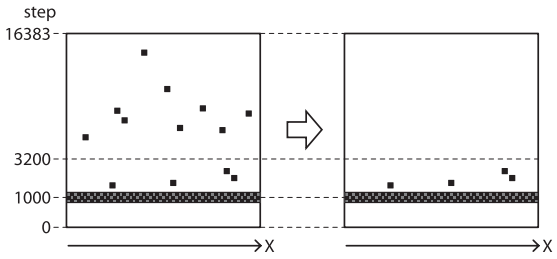
4 Execute opaque defect point detection. Like the clear defect point detection, set the image pickup conditions and the threshold in units of 14 bits. Below is an example for 10000 step/14bit. Pixels that indicate 0 to 10000 steps are detected. If are not setting opaque defect points, you can skip this step.
>DefectThreshold=10000
>DefectDetectionMode=2



5 Select the data for applying defect correction. To apply the pixels detected in steps 3 and 4, select 2. To apply factory settings, select 0. To apply values that have been saved, select 1.
>DefectPatternLoad=2

Register	Parameter	Setting
DefectPatternLoad	0	Factory setting
	1	User setting
	2	Data detected using DEFECT-DETECTION

6 Turn on defect detection correction.
>AcquisitionStart
>DefectCorrection=1



7 Save the settings. To repeat defect detection without saving, repeat steps 1 to 6.
>DefectPatternSave

Note

The upper limit of defect detection points is 2047 for clear and opaque defect points combined. Correction cannot be performed over the upper limit. The detected defect points can be confirmed using the DefectDetectionResult register. If the upper limit is exceeded, defect detection will fail or abnormal defect detection will occur, and the DefectDetectionResult register value will be -1. Perform the defect detection after the image transfer is set to off.

Shading Correction

Depending on the characteristics of the lens, shadings caused by a drop in the amount of light around the lens, or light source variation, are corrected. 35 patterns in XCG-CG160/CG160C, 20 patterns in XCG-CG240/CG240C, and 9 patterns in XCG-CG510/CG510C can be stored as user settings.
Shading Correction has two modes. In peak detection mode, you can adjust the screen to brightest level. In average detection mode, you can adjust the whole screen to its average brightness.

Register	Parameter	Setting
ShadingDetectionMode	0	Check that the detection is completed
	1	Start detection (peak detection)
	2	Start detection (average detection)

Register	Parameter	Setting
ShadingCorrection	0	Correction off
	1	Correction on

	ShadingPatternSelect
XCG-CG160/CG160C	0 to 34
XCG-CG240/CG240C	0 to 19
XCG-CG510/CG510C	0 to 8

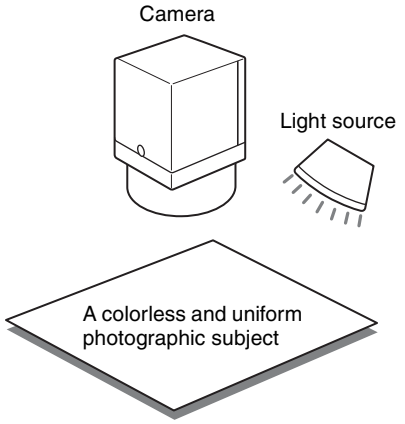
Register	Parameter	Setting
ShadingPatternSave	1	Save shading patterns

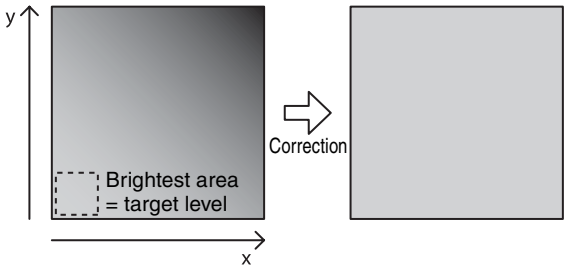
Register	Parameter	Setting
ShadingPatternLoad	1	Read shading patterns

Register	Parameter	Setting
ShadingDetectColor	'R'	RED
	'G'	GREEN
	'B'	BLUE
	'Y'	Brightness

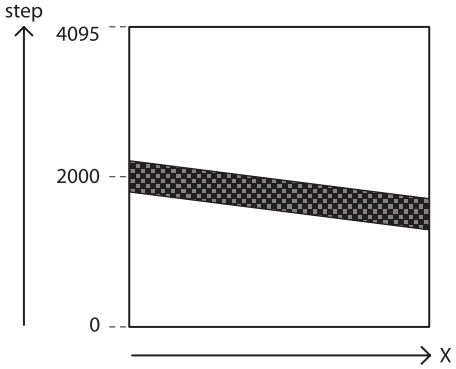
Shading detection setup procedure

1 As shown in the figure below, assume an environment in which the brightness is not uniform due to an uneven light source. Shading correction adjusts the brightness levels taking the brightest level to be the target level.
Fix the lens and lighting conditions.





2 Adjust the exposure time and other parameters so that the target level is about 50%. On color cameras, adjust the white balance.



3 Perform the shading detection after the image transfer is stopped.
>AcquisitionStop
>ShadingDetectionMode=1
Read the Status to determine whether the calculation is finished.
>Readout ShadingDetectionMode
1 (running)
2 (finished)
Return to 0 when finished.

4 Determine the effect of shading correction
>AcquisitionStart
>ShadingCorrection=1
>ShadingPatternSelect=19
Parameter 19 is available only after detecting an operation, and will not be available when the power is off.

5 Save the shading pattern
>ShadingPatternSelect=0
>ShadingPatternSave=1

6 Readout the saved pattern
>ShadingPatternSelect=0
>ShadingPatternLoad=1

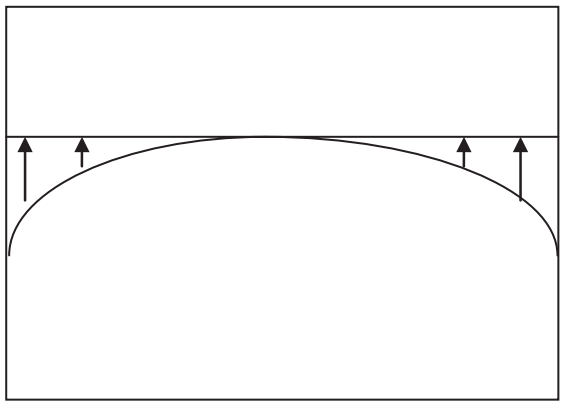
Note

Perform the shading detection after the trigger mode and the image transfer are set to off. Reset the camera once if the shading detection cannot be finished.

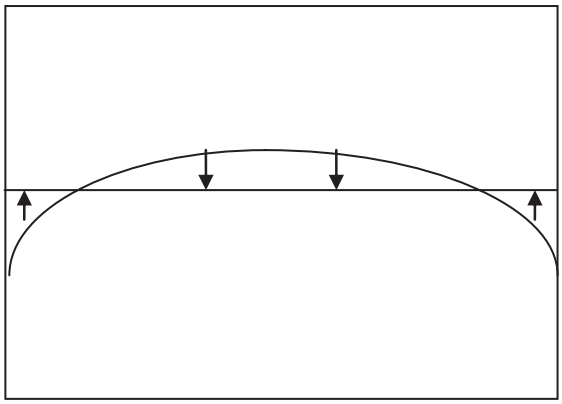
Upon launching, it takes 3 minutes max after turning on the power and connecting to the network to read out the shading patterns.
If you turn ON the shading correction before completion of the reading, the correction might not start immediately.
To make sure the correction is performed properly, use the function after confirming the pattern formatting completion flag turns to 1.
>Read out ShadingInitialLoadFinished
0 Reading out
1 Readout completed

Peak detection mode

All parts tend to become brighter.



Average value detection mode
Brighter part of the object might be darker.



User Set

Main set values can be saved to the channels 1 to 16 of USERSET. Refer to “Command List” (page 47) for items to be saved. The factory setting is saved to channel 0, which cannot be overwritten.

Setting example (1):
Shutter is 3 ms, Gain is 3 dB, Pulse signal is output to GPO3 connector (this setting is saved to the channel 1).
ExposureTime=3000
Gain=30
LineSelector=Line3
LineMode=Output
LineSource=PWM
UserSetSelector=1
UserSetSave

Setting example (2):
The user set saved in the channel 2 is loaded.
UserSetSelector=2
UserSetLoad

User set memory

This is one of the items to be saved in the user set channel. Signed 32-bit numbers are assigned to slots 0 to 15.

User ID

User IDs are unique names that can be assigned to cameras. A string that is 15 characters long can be assigned.

Register	Parameter
DeviceUserID	15 characters of your choice

Saving and Startup

The startup setting can be determined by UserSetDefaultSelector. This is also used to check which user set settings are currently being used.

Usage example:
Startup with the setting saved in the user set channel 3.
UserSetDefaultSelector=3
(Restart or CameraReboot command)

Check which user set settings are the current settings.
Read UserSetDefaultSelector

Camera Information

The model name of a camera or its firmware information can be read out.

Register	Parameter
DeviceVendorName	Manufacture name (SONY)
DeviceModelName	Model name
DeviceVersion	Firmware version
DeviceSerialNumber	Serial number
DeviceManufacturerInfo	Data for service

Restart

The camera is rebooted.
A time after receiving a command until rebooting can be set in milliseconds (ms).

Register
CameraReboot
CameraRebootDelayTime

Command List

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0x0048	VendorName	Vendor Name	●	–	"SONY"		–	–
0x0068	ModelName	Model Name	●	–	"XCG-CG160"	"XCG-CG160C"	–	–
					"XCG-CG240"	"XCG-CG240C"		
					"XCG-CG510"	"XCG-CG510C"		
	DeviceVersion	Version	●	–	"VERSION *.*.*"		–	–
0x00A8	Device ManufacturerInfo	Manufacturer information	●	–	****-****-****-****		–	–
0x00E8	UserDefinedName	User Defined Name	●	●			–	–
0xA000	Width	Width of output image	●	●	16 to (1440) to 1456	16 to (1440) to 1456	●	–
					16 to (1920) to 1936	16 to (1920) to 1936		
					16 to (2448) to 2464	16 to (2448) to 2464		
0xA004	Height	Height of output image	●	●	16 to (1080) to 1088	16 to (1080) to 1088	●	–
					16 to (1200) to 1216	16 to (1200) to 1216		
					16 to (2048) to 2056	16 to (2048) to 2056		
0xA008	OffsetX	Output image OffsetX	●	●	(0) to 1440	(0) to 1440	●	–
					(0) to 1920	(0) to 1920		
					(0) to 2448	(0) to 2448		
0xA00C	OffsetY	Output image OffsetY	●	●	(0) to 1080	(0) to 1080	●	–
					(0) to 1200	(0) to 1200		
					(0) to 2040	(0) to 2040		
0xA010	AcquisitionMode	Acquisition mode	●	●	(0) / 1 / 3		●	–
0xA014	AcquisitionStart	Starting image transfer	–	●	1 (readout is disabled)			
0xA018	AcquisitionStop	Stop image transfer	–	●	1 (readout is disabled)			
0xA01C	PixelFormat	Pixel format	●	●	(0x01080001) 0x010C0004 0x010C0006	XCG-CG160/XCG-CG510 0x01080008 to (0x01080009) to 0x0108000B 0x010C0026 to 0x010C0029 0x010C002A to 0x010C002D 0x02180014 to 0x02180015 0x0210001F 0x02180020 0x02100032	●	–
						XCG-CG240 0x01080008 to (0x0108000B) 0x010C0026 to 0x010C0029 0x010C002A to 0x010C002D 0x02180014 to 0x02180015 0x0210001F 0x02180020 0x02100032		
0xA0000008	ReverseX/ReverseY	Image reverse	●	●	(0) / 1 / 2 / 3		–	–
0xA0000014	CameraTemperature	Readout device temperature	●	–	0x00 to 0xFF		–	–
0xA0000018	CameraTemperature Measurement Interval	Temperature readout interval	●	●	(0) to 0xFFFFFFFF		–	–
0xA0000020	GevVesionForStart Up	Switching of GEV1.2/2.0	●	●	(0x00010002) / 0x00020000		–	–

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA0000030	DriveMode	CMOS Normal mode/High-speed mode (enabled at the next startup)	●	●	(0) / 1		–	–
0xA0000034	DriveModeCurrent	CMOS Normal mode/High-speed mode (current status)	●	–	(0) / 1		–	–
0xA0000134	DetectAreaGain AutoMode	Highlight AGC/AE detection frame	●	●	(0) / 1		–	–
0xA0000138	DetectAreaGain AutoWidth	Width of AGC/AE detection frame	●	●	1 to (50) to 100		●	●
0xA000013C	DetectAreaGain AutoHeight	Height of AGC/AE detection frame	●	●	1 to (50) to 100		●	●
0xA0000140	DetectAreaGain AutoOffsetX	AGC/AE detection frame X	●	●	0 to (25) to 99		●	●
0xA0000144	DetectAreaGain AutoOffsetY	AGC/AE detection frame Y	●	●	0 to (25) to 99		●	●
0xA0000154	DetectAreaBalance WhiteAutoMode	Highlight AWB detection frame	●	●	–	(0) / 1	–	–
0xA0000158	DetectAreaBalance WhiteAutoWidth	Width of AWB detection frame	●	●	–	1 to (50) to 100	●	●
0xA000015C	DetectAreaBalance WhiteAutoHeight	Height of AWB detection frame	●	●	–	1 to (50) to 100	●	●
0xA0000160	DetectAreaBalance WhiteAutoOffsetX	AWB detection frame X	●	●	–	0 to (25) to 99	●	●
0xA0000164	DetectAreaBalance WhiteAutoOffsetY	AWB detection frame Y	●	●	–	0 to (25) to 99	●	●
0xA0000220	AcquisitionFrame Rate	Frame rate	●	●	xxxxxxxxxx 0x42240000 (41.0) 0x41B80000 (23.0)		–	–
0xA0000224	AcquisitionFrame RateAuto	Frame rate auto	●	●	0 / (1)			
0xA0000228	AcquisitionFrame RateActual	Readout the actual frame rate	●	–	xxxxxxxxxx 0x42269E56 (41.654624938964844) 0x419D9DE3 (19.702093124389648)		–	–
0xA0000300	SpecialTrigger Mode	Special trigger mode	●	●	(0) / 1 / 2		–	–
0xA0000304	NumberOfMemory ForSpecialTrigger Mode	Number of UserSets used for special trigger mode	●	●	1 to (2) to 16		–	–
0xA00002F0	SpecialTrigger Source	Special trigger source	●	●	(0) / 1 / 2 / 4		–	–
0xA00002F4	SpecialTrigger Activation	Special trigger polarity	●	●	(0) / 1		–	–
0xA00002F8	TriggerSoftware	Software trigger issuing	●	●	(0) / 1		–	–
0xA0002040	ExposureTime	Exposure time	●	●	XCG-CG160/CG160C/CG510/CG510C 1 to (42000) to 60000000 XCG-CG240/CG240C 1 to (23300) to 60000000		●	●
0xA0002044	TriggerMode	Trigger mode	●	●	(0) / 1		●	●
0xA0002050	TriggerInhibit	Trigger inhibit	●	●	(0) / 1		●	●
0xA0002058	TriggerDelay	Trigger delay	●	●	(0) / 1		●	●
0xA0002098	TriggerSource	Trigger Source	●	●	(0) / 1 / 2 / 4 / 15		●	●
0xA00020B8	ExposureMode	Exposure mode	●	●	(0) / 1		●	●

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA00020BC	TriggerActivation	Trigger polarity	●	●	(0) / 1		●	●
0xA0002048	TriggerCounter	Trigger counter	●	–	0 to 0xFFFFFFFF		–	–
0xA000204C	TriggerCounter Reset	Trigger counter reset	–	●	1		–	–
0xA0003000	GainDigitalRedAll	R gain	●	●	256 to (individually set) to 4095		●	●
0xA0003008	GainDigitalGreen All	G gain	●	●	(256) to 4095		●	●
0xA0003018	GainDigitalBlueAll	B gain	●	●	256 to (individually set) to 4095		●	●
0xA0003020	BalanceWhiteAuto	AWB	●	●	(0) / 1 / 2		●	●
0xA00030A0	GainAnalogRaw	Analog gain	●	●	individually set to (0) to individually set		●	●
0xA00030B0	GainSelector	Gain selector	●	●	(0x10) / 0x30 / 0x40 / 0x60		–	–
0xA000704C	BlackLevelMin	Readout the black level minimum value	●	–	0		–	–
0xA0007048	BlackLevelMax	Readout the black level maximum value	●	–	2047		–	–
0xA0002038	BlackLevelRaw	Black level setting	●	●	0 to (960) to 2047		●	●
0xA0002140	ExposureAuto	AE mode	●	●	(0) / 1 / 2		●	●
0xA0002144	ExposureAuto Speed	Following speed of AE mode	●	●	1 to (192) to 256		●	●
0xA00030D8	ExposureAuto SpeedMin	Readout the minimum value of AE following speed	●	–	1		–	–
0xA00030DC	ExposureAuto SpeedMax	Readout the maximum value of AE following speed	●	–	256		–	–
0xA0002148	ExposureAuto LowerLimit	Setting of AE limit minimum value	●	●	1 to (10) to 60000000		●	●
0xA000214C	ExposureAuto UpperLimit	Setting of AE limit maximum value	●	●	XCG-CG160/CG160C/CG510/CG510C 1 to (9593) to 60000000		●	●
					XCG-CG240/CG240C 1 to (7674) to 60000000			
0xA000201C	GainAuto	AGC mode	●	●	(0) / 1 / 2		●	●
0xA0002020	GainAutoLevel	AGC target level	●	●	0 to (11264) to 16383		●	●
0xA0007034	GainAutoLevelMin	Readout the AGC target level minimum value	●	–	0		–	–
0xA0007030	GainAutoLevel Max	Readout the AGC target level maximum value	●	–	0x3FFF		–	–
0xA0002154	GainAutoSpeed	AGC following speed	●	●	1 to (192) to 256		●	●
0xA00030FC	GainAutoSpeed Min	Readout the minimum value of AGC following speed	●	–	1		–	–
0xA0003100	GainAutoSpeed Max	Readout the maximum value of AGC following speed	●	–	256		–	–
0xA0002158	GainAutoLower Limit	Setting of AGC limit minimum value	●	●	0		●	●
0xA000215C	GainAutoUpper Limit	Setting of AGC limit maximum value	●	●	180		●	●

Initial set value for each item is indicated within ( ).

● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA0007000	WidthMax	Acquisition of the image width maximum value	●	–	1456 1936 2464		–	–
0xA0007004	WidthMin	Acquisition of the image width minimum value	●	–	16		–	–
0xA0007008	HeightMax	Acquisition of the image height maximum value	●	–	1088 1216 2056		–	–
0xA000700C	HeightMin	Acquisition of the image height minimum value	●	–	16		–	–
0xA0007010	AcquisitionFrame RateMax	Readout the frame rate maximum value	●	–	0x44FA0000 (2000)		–	–
0xA0007014	AcquisitionFrame RateMin	Readout the frame rate minimum value	●	–	0x3D800000 (0.0625)		–	–
0xA0007020	GainAnalogMax	Readout the analog gain maximum value	●	–	Individually set		–	–
0xA0007024	GainAnalogMin	Readout the analog gain minimum value	●	–	Individually set		–	–
0xA00070C0	GainDigitalMax	Readout the pixel gain maximum value	●	–	4095		–	–
0xA00070C4	GainDigitalMin	Readout the pixel gain minimum value	●	–	256		–	–
0xA0007058	ExposureTimeMax	Acquisition of the exposure time maximum value	●	–	60000000		–	–
0xA000705C	ExposureTimeMin	Acquisition of the exposure time minimum value	●	–	1		–	–
0xA0007060	TriggerDelayMax	Acquisition of the trigger delay maximum value	●	–	4000000		–	–
0xA0001000	UserSetSelector	User set selector	●	●	(0) to 16		–	–
0xA0001004	UserSetSave	User set save	–	●	(Readout is disabled)		–	–
0xA0001008	UserSetLoad	User set load	–	●	(Readout is disabled)		–	–
0xA000100C	UserSetDefault	User set default	●	●	(0) to 16		–	–
0xA0001010	UserMemoryIndex	User memory index	●	●	(0) to 15		–	–
0xA00020C0 - 0xA00020FC	UserMemoryValue	User memory value	●	●	0x0 to 0xFFFFFFFF		●	●
0xA0002060	LUTEnable	LUT enable	●	●	(0) / 1		●	●
0xA000205C	LUTFormat	LUT format	●	●	(0) / 1 / 2 / 3 / 4		●	●
0xA0002064	Binarization Threshold	Binarization threshold	●	●	0 to (2047) to 4095		●	●
0xA0000350	LUTIndex	LUT user set index	●	●	0 to 4095		–	–
0xA0010000	LUTValue	LUT user set data	●	●	0 to 4095		–	–
0xA0020000 - 0xA0023FFC	LUTValueFlat	LUT user set value						
0xA0000340	LinearInterpolation Index	Linear interpolation index	●	●	1 to 5		–	–

Initial set value for each item is indicated within ( ).

● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA0000344	LinearInterpolation InValue	Linear interpolation value	●	●	0 to 4095		–	–
0xA0000348	LinearInterpolation OutValue	Linear interpolation out value	●	●	0 to 4095		–	–
0xA000034C	LinearInterpolation Build	Linear interpolation build	–	●	1		–	–
0xA0002074	LUTValueSave	Store the user set LUT in the flash	–	●	1		–	–
0xA0000354	LineSelector	Line selector	●	●	(0) / 1 / 2		–	–
0xA0001204	LineMode(Line1)	Line mode (Line1)	●	●	0		–	–
0xA0001208	LineMode(Line2)	Line mode (Line2)	●	●	(0) / 1		●	●
0xA000120C	LineMode(Line3)	Line mode (Line3)	●	●	(0) / 1		●	●
0xA0001218	LineInverter(Line2)	Line inverter (Line2)	●	●	0 / (1)		●	●
0xA000121C	LineInverter(Line3)	Line inverter (Line3)	●	●	0 / (1)		●	●
0xA0001224	LineStatus(Line1)	Line status (Line1)	●	–	–		–	–
0xA0001228	LineStatus(Line2)	Line status (Line2)	●	–	–		–	–
0xA000122C	LineStatus(Line3)	Line status (Line3)	●	–	–		–	–
0xA0001238	LineSource(Line2)	Line source (Line2)	●	●	0 to (2) to 10		●	●
0xA000123C	LineSource(Line3)	Line source (Line3)	●	●	0 to (2) to 10		●	●
0xA0001248	StrobeActiveTime (Line2)	Strobe active time (Line2)	●	●	1 to (256) to 40000		●	●
0xA000124C	StrobeActiveTime (Line3)	Strobe active time (Line3)	●	●	1 to (256) to 40000		●	●
0xA0001258	StrobeActiveDelay (Line2)	Strobe delay (Line2)	●	●	0 to (100) to 40000		●	●
0xA000125C	StrobeActiveDelay (Line3)	Strobe delay (Line3)	●	●	0 to (100) to 40000		●	●
0xA0001260	UserOutputSelector	User output selector	●	●	(0) to 2		–	–
0xA0001264	UserOutputValue(0)	User output (0)	●	●	(0) / 1		●	●
0xA0001268	UserOutputValue(1)	User output (1)	●	●	(0) / 1		●	●
0xA000126C	UserOutputValue(2)	User output (2)	●	●	(0) / 1		●	●
0xA0000010	CameraReboot	Device reset	–	●	–		–	–
0xA0000130	TestImageSelector	Test image selector	●	●	(0) / 1 / 3		–	–
0x0D24	ExtendedChunk Mode	Extended chunk mode	●	●	(0) / 1		–	–
0xA100	ChunkModeActive	Enable chunk mode	●	●	(0) / 1		–	–
0xA200	ChunkEnable	Enable chunk data 0 (Temperature information)	●	●	(0) / 1		–	–
0xA210	ChunkEnable	Enable chunk data 1 (Line status)	●	●	(0) / 1		–	–
0xA220	ChunkEnable	Enable chunk data 2 (Exposure time)	●	●	(0) / 1		–	–
0xA230	ChunkEnable	Enable chunk data 3 (Gain)	●	●	(0) / 1		–	–
0xA240	ChunkEnable	Enable chunk data 4 (Pixel gain)	●	●	(0) / 1		–	–
0xA250	ChunkEnable	Enable chunk data 5 (User memory)	●	●	(0) / 1		–	–
0xA0001800	SpatialFilterEnable	Enable 3 × 3 spatial filter	●	●	(0) / 1		●	●
0xA0001804	SpatialFilter SelectorRow	Specify parameter position (Row)	●	●	(0) / 1 / 2		–	–
0xA0001808	SpatialFilter SelectorColumn	Specify parameter position (Column)	●	●	(0) / 1 / 2		–	–

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA000180C	SpatialFilterValue	Parameter value	●	●	-8191 to (0) to 8191		–	–
0xA0001810	SpatialFilterTop Left	For specifying individual parameter of 3 × 3 spatial filter	●	●	-8191 to (0) to 8191		●	●
0xA0001814	SpatialFilterTop Center		●	●	-8191 to (0) to 8191		●	●
0xA0001818	SpatialFilterTop Right		●	●	-8191 to (0) to 8191		●	●
0xA0001820	SpatialFilterCenter Left		●	●	-8191 to (0) to 8191		●	●
0xA0001824	SpatialFilterCenter Center		●	●	-8191 to (256) to 8191		●	●
0xA0001828	SpatialFilterCenter Right		●	●	-8191 to (0) to 8191		●	●
0xA0001830	SpatialFilterBottom Left		●	●	-8191 to (0) to 8191		●	●
0xA0001834	SpatialFilterBottom Center		●	●	-8191 to (0) to 8191		●	●
0xA0001838	SpatialFilterBottom Right		●	●	-8191 to (0) to 8191		●	●
0xA0001900	ColorMatrixEnable	Enable color matrix	●	●	–	(0) / 1	●	●
0xA0001904	ColorMatrix SelectorRow	Specify parameter position (Row)	●	●	–	(0) / 1 / 2	–	–
0xA0001908	ColorMatrix SelectorColumn	Specify parameter position (Column)	●	●	–	(0) / 1 / 2	–	–
0xA000190C	ColorMatrixValue	Parameter value	●	●	–		–	–
0xA0001910	ColorMatrixTop Left	For specifying individual parameter of color matrix	●	●	–	-8191 to (256) to 8191	●	●
0xA0001914	ColorMatrixTop Center		●	●	–	-8191 to (0) to 8191	●	
0xA0001918	ColorMatrixTop Right		●	●	–	-8191 to (0) to 8191	●	●
0xA0001920	ColorMatrixCenter Left		●	●	–	-8191 to (0) to 8191	●	●
0xA0001924	ColorMatrixCenter Center		●	●	–	-8191 to (256) to 8191	●	●
0xA0001928	ColorMatrixCenter Right		●	●	–	-8191 to (0) to 8191	●	●
0xA0001930	ColorMatrixBottom Left		●	●	–	-8191 to (0) to 8191	●	●
0xA0001934	ColorMatrixBottom Center		●	●	–	-8191 to (0) to 8191	●	●
0xA0001938	ColorMatrixBottom Right		●	●	–	-8191 to (256) to 8191	●	●
0xA0002180	DefectThreshold	Defect detection threshold	●	●	0 to (8192) to 16383		–	–
0xA0002184	DefectDetection Mode	Starting defect detection	●	●	(0) / 1 / 2		–	–
0xA0002188	DefectDetection Result	Acquisition of the defect detection result	●	–	Maximum 2047		–	–
0xA000218C	DefectPatternSave	Saving defect data	●	●	(0) / 1		–	–
0xA0002190	DefectPatternLoad	Loading defect data	–	●	(0) / 1 / 2		–	–
0xA0002194	DefectCorrection	Defect correction	●	●	(0) / 1		–	–
0xA0002100	ShadingDetection Mode	Shading detection	●	●	(0) / 1 / 2		–	–

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA0002120	ShadingPattern Select	Shading pattern selection	●	●	(0) to 34		●	●
					(0) to 19			
					(0) to 8			
0xA0002104	ShadingPatternSave	Saving shading pattern	●	●	(0) / 1		–	–
0xA0002108	ShadingPattern Load	Loading shading pattern	–	●	1		–	–
0xA000210C	ShadingCorrection	Shading correction	●	●	(0) / 1		●	●
0xA0002110	ShadingBlockSize	Block size for shading correction	●	–	4		–	–
0xA0002120	ShadingPattern Check	Data check of shading detection	–	●	1			
0xA0002128	ShadingInitialLoad Finished	Pattern readout on launching completed	●	–	(0) / 1		–	–
0x0954	GevIEEE1588	Grandmaster clock synchronization	●	●	(0) / 0x00080000		–	–
0xA0002510	PTPTriggerInterval	PTP synchronization trigger cycle	●	●	1 to (1000) to 10000000		●	●
0xA0002514	PTPTriggerStart Time	Setup the start time of PTP synchronization trigger	●	●	0		–	–
0xA00022FC	AreaGainEnableAll	Enable partial gain function	●	●	(0) / 1		●	●
0xA0002300	AreaGainEnable	Enable partial gain area (0)	●	●	(0) / 1		●	●
0xA0002304	AreaGainOffsetX/ AreaGainOffsetY	Partial gain area (0) Upper left coordinate	●	●	0 to 1088 : 0 to 1080	0 to 1088 : 0 to 1080	●	●
					0 to 1928 : 0 to 1208	0 to 1928 : 0 to 1208		
					0 to 2456 : 0 to 2048	0 to 2456 : 0 to 2048		
0xA0002308	AreaGainWidth/ AreaGainHeight	Partial gain area (0) Width, Height	●	●	8 to (128) to 1456 : 8 to (128) to 1088	8 to (128) to 1456 : 8 to (128) to 1088	●	●
					8 to (128) to 1936 : 8 to (128) to 1216	8 to (128) to 1936 : 8 to (128) to 1216		
					8 to (128) to 2464 : 8 to (128) to 2056	8 to (128) to 2464 : 8 to (128) to 2056		
0xA000230C	AreaGainValue	Partial gain area (0) Gain	●	●	0 to (256) to 8191		●	●
0xA0002310		Enable partial gain area (1)	●	●	(0) / 1		●	●
0xA0002314		Partial gain area (1) Upper left coordinate	●	●	0 to 1088 : 0 to 1080	0 to 1088 : 0 to 1080	●	●
					0 to 1928 : 0 to 1208	0 to 1928 : 0 to 1208		
					0 to 2456 : 0 to 2048	0 to 2456 : 0 to 2048		
0xA0002318		Partial gain area (1) Width, Height	●	●	8 to (128) to 1456 : 8 to (128) to 1088	8 to (128) to 1456 : 8 to (128) to 1088	●	●
					8 to (128) to 1936 : 8 to (128) to 1216	8 to (128) to 1936 : 8 to (128) to 1216		
					8 to (128) to 2464 : 8 to (128) to 2056	8 to (128) to 2464 : 8 to (128) to 2056		
0xA000231C		Partial gain area (1) Gain	●	●	0 to (256) to 8191		●	●
0xA00023F0		Enable partial gain area (15)	●	●	(0) / 1		●	●
0xA00023F4		Partial gain area (15) Upper left coordinate	●	●	0 to 1088 : 0 to 1080	0 to 1088 : 0 to 1080	●	●
					0 to 1928 : 0 to 1208	0 to 1928 : 0 to 1208		
					0 to 2456 : 0 to 2048	0 to 2456 : 0 to 2048		

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA00023F8		Partial gain area (15) Width, Height	●	●	8 to (128) to 1456 : 8 to (128) to 1088	8 to (128) to 1456 : 8 to (128) to 1088	●	●
					8 to (128) to 1936 : 8 to (128) to 1216	8 to (128) to 1936 : 8 to (128) to 1216		
					8 to (128) to 2464 : 8 to (128) to 2056	8 to (128) to 2464 : 8 to (128) to 2056		
0xA00023FC		Partial gain area (15) Gain	●	●	0 to (256) to 8191		●	●
0xA0002500	FastTriggerMode	Sequential trigger mode/Fast trigger mode	●	●	XCG-CG160/CG160C/CG510/CG510C 0 / (1)		●	●
					XCG-CG240/CG240C 0 / (1)			
0xA0000114	BinningVertical	Binning vertical	●	●	(1) / 2	–	●	–
					–			
					–			
0xA0000118	BinningHorizontal	Binning horizontal	●	●	(1) / 2	–	●	–
					–			
					–			
0xA0002404	MultiROIMode	Multi ROI mode	●	●	(0) / 1 / 2		●	●
					–			
					–			
0xA0002410	MultiROIEnable	Enable Multi ROI (0)	●	●	0 / (1)		●	●
					–			
					–			
0xA0002414	MultiROIOffsetX/ MultiROIOffsetY	MultiROI area (0) Upper left coordinate	●	●	0 to (128) to 1452 : 0 to (128) to 1084		●	●
					–			
					–			
0xA0002418	MultiROIWidth/ MultiROIHeight	MultiROI area (0) Width, Height	●	●	4 to (128) to 1456 : 4 to (128) to 1088		●	●
					–			
					–			
0xA0002420	MultiROIEnable	Enable MultiROI area (1)	●	●	0 / (1)		●	●
					–			
					–			
0xA0002424	MultiROIOffsetX/ MultiROIOffsetY	MultiROI area (1) Upper left coordinate	●	●	0 to (384) to 1452 : 0 to (384) to 1084		●	●
					–			
					–			
0xA0002428	MultiROIWidth/ MultiROIHeight	MultiROI area (1) Width, Height	●	●	4 to (128) to 1456 : 4 to (128) to 1088		●	●
					–			
					–			
0xA0002522	BurstMode	Burst trigger mode	●	●	(0) / 1 / 2		●	●
0xA0002520	BurstPeriod	Burst trigger period	●	●	(0) / 1		●	●
0xA0002528	BurstFrameCount	Burst trigger frame count	●	●	0 to (1) to 65533		●	●
0xA000252C	BurstForceStop	Burst trigger force stop	–	●	1		–	–
0xA0002530	Exposure2Time	Second Exposure time	●	●	1 to (84000) to 60000000		●	●

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

*1 The items that can be saved in the UserSet but cannot be loaded from the UserSet are loaded only when stating the camera.

Address	Register name	Function name	Read-out	Write	Upper stage: XCG-CG160 Middle stage: XCG-CG240 Bottom row: XCG-CG510	Upper stage: XCG-CG160C Middle stage: XCG-CG240C Bottom row: XCG-CG510C	Items that can be saved in the UserSet (16 channels)	Items that can be loaded from the UserSet (16 channels) *1
0xA0002534	Exposure2Ratio	Second Exposure time ratio (Compare with First Exposure time)	●	●	1 / (2) / 4 / 8 / 16		●	●
0xA00026A0	FreeSetTrigger Source	Free Set trigger source	●	●	(0) / 1 / 2 / 4 / 15		–	–
0xA00026A4	FreeSetStop	FreeSet stop	–	●	1		–	–
0xA00026A8	FreeSet1Cycle	FreeSet 1 Cycle period	●	●	(0) to 10000000		–	–
0xA00026AC	FreeSet1CycleNum	Number of repetitions for FreeSet	●	●	0 to (1) to 65533		–	–
0xA00026B0	FreeSetSave	FreeSet save setting	–	●	1		–	–
0xA00026B4	FreeSetLoad	Readout FreeSet setting	–	●	1		–	–
0xA0002580	FreeSetLine2Delay	FreeSet Line2 first pulse output delay	●	●	(-1) to 10000000		–	–
0xA0002584	FreeSetLine2 Duration	FreeSet Line2 first pulst output width	●	●	(0) to 10000000		–	–
0xA00025C8	FreeSetLine2Delay	FreeSet Line2 tenth pulse output delay	●	●	(-1) to 10000000		–	–
0xA00025CC	FreeSetLine2 Duration	FreeSet Line2 tenth pulst output width	●	●	(0) to 10000000		–	–
0xA00025D0	FreeSetLine3Delay	FreeSet Line3 first pulse output delay	●	●	(-1) to 10000000		–	–
0xA00025D4	FreeSetLine3 Duration	FreeSet Line3 first pulst output width	●	●	(0) to 10000000		–	–
0xA0002618	FreeSetLine3Delay	FreeSet Line3 tenth pulse output delay	●	●	(-1) to 10000000		–	–
0xA000261C	FreeSetLine3 Duration	FreeSet Line3 tenth pulst output width	●	●	(0) to 10000000		–	–
0xA0002620	FreeSetExpDelay	FreeSet start Exposure delay	●	●	(-1) to 10000000		–	–
0xA0002624	FreeSetExp Duration	FreeSet Exposure duration	●	●	(0) to 10000000		–	–
0xA0002668	FreeSetExpDelay	FreeSet start tenth Exposure delay	●	●	(-1) to 10000000		–	–
0xA000266C	FreeSetExp Duration	FreeSet tenth Exposure duration	●	●	(0) to 10000000		–	–
0xA0002670	FreeSetGain	FreeSet first Exposure gain	●	●	Individually set to (0) to Individually set		–	–
0xA0002694	FreeSetGain	FreeSet tenth Exposure gain	●	●	Individually set to (0) to Individually set		–	–

Initial set value for each item is indicated within ( ).
● Usable function, – Not usable function

Specifications

Pickup device CMOS image sensors with a global shutter function
XCG-CG160/CG160C: 1/2.9 type
XCG-CG240/CG240C: 1/1.2 type
XCG-CG510/CG510C: 2/3 type

Standard video output size (horizontal/vertical)
XCG-CG160/CG160C: 1,440 × 1,080
XCG-CG240/CG240C: 1,920 × 1,200
XCG-CG510/CG510C: 2,448 × 2,048

Frame rate (during 1000BASE-T operation)
XCG-CG160/CG160C: 75 fps
XCG-CG240/CG240C: 41 fps
XCG-CG510/CG510C: 23 fps

Lens mount C-mount

Flange focal length
17.526 mm

Video output signal
XCG-CG160/CG240/CG510:
Mono 8 bits (default setting)/10 bits/12 bits
XCG-CG160C/CG240C/CG510C:
Raw 8 bits (default setting)/10 bits/12 bits, RGB 24 bits, YUV 24 bits, YUV 16 bits

Reference video output level
235 steps (8 bits)/3,760 steps (12 bits)

Reference pedestal level
16 steps (8 bits)/256 steps (12 bits)

Range of color temperature for white balance (color camera only)
XCG-CG160C/CG240C/CG510C:
2,400 K to 9,000 K

Minimum illumination
XCG-CG240:
0.5 lx (gain control at +18 dB, F1.4, shutter speed at 1/30 sec)
XCG-CG240C:
10 lx (gain control at +18 dB, F1.4, shutter speed at 1/30 sec)
XCG-CG510:
0.5 lx (gain control at +18 dB, F1.4, shutter speed at 1/23 sec)
XCG-CG510C:
10 lx (gain control at +18 dB, F1.4, shutter speed at 1/23 sec)
XCG-CG160:
0.5 lx (gain control at +18 dB, F1.4, shutter speed 1/30 sec)
XCG-CG160C:
12l x (gain control at +18 dB, F1.4, shutter speed 1/30 sec)

Sensitivity XCG-CG240:
F5.6 (gain control at 0 dB, 400 lx, shutter speed at 1/30 sec)
XCG-CG240C:
F5.6 (gain control at 0 dB, 2,000 lx, shutter speed at 1/30 sec)
XCG-CG510:
F8 (gain control at 0 dB, 400 lx, shutter speed at 1/23 sec)
XCG-CG510C:
F8 (gain control at 0 dB, 2,000 lx, shutter speed at 1/23 sec)
XCG-CG160:
F5.6 (gain control at 0 dB, 400 lx, shutter speed 1/30 sec)
XCG-CG160C:
F5.6 (gain control at 0 dB, 2,000 lx, shutter speed 1/30 sec)

Gain 0 dB to 18 dB, Auto gain

Shutter speed XCG-CG240/CG240C:
1/40,000 sec to 60 sec, automatic shutter (Quality is secured for 2 sec. at most)
XCG-CG160/CG160C, XCG-CG510/CG510C:
1/100,000 sec to 60 sec, automatic shutter (Quality is secured for 2 sec. at most)

Gamma γ = 1 (Changeable by LUT)

External power DC 12 V (10.5 V to 15 V): DC IN connector/IEEE802.3af (37 V to 57 V): RJ45 connector

Power consumption
XCG-CG160/CG160C:
4.0 W (PoE)/3.3 W (DC 12 V)
XCG-CG240/CG240C:
3.6 W (PoE)/3.0 W (DC 12 V)
XCG-CG510/CG510C:
3.7 W (PoE)/3.3 W (DC 12 V)

Performance guarantee temperature
0 °C to 40 °C (32 °F to 104 °F)

Operating temperature
–5 °C to +45 °C (23 °F to 113 °F)

Storage temperature
–30 °C to +60 °C (–22 °F to +140 °F)

Operating relative humidity
20% to 80% (no condensation)

Storage relative humidity
20% to 95% (no condensation)

MTBF XCG-CG160/CG160C:
approx. 6.7 years
XCG-CG240/CG240C:
approx. 7.2 years
XCG-CG510/CG510C:
approx. 7.1 years

Vibration resistance
10 G (20 Hz to 200 Hz)

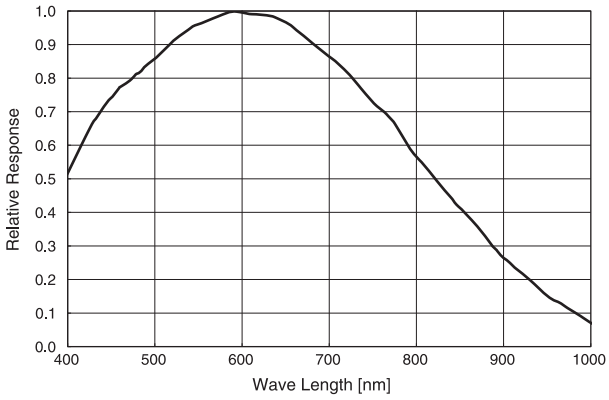
Shock resistance
70 G

External dimension (w/h/d)	29 × 29 × 42 mm (1 $^{3}/_{16}$ × 1 $^{3}/_{16}$ × 1 $^{11}/_{16}$ inches) (excluding protrusions)
Mass About	Approx. 65 g (2 oz)
Accessories	Lens mount cap (1) Operating Instructions (1)

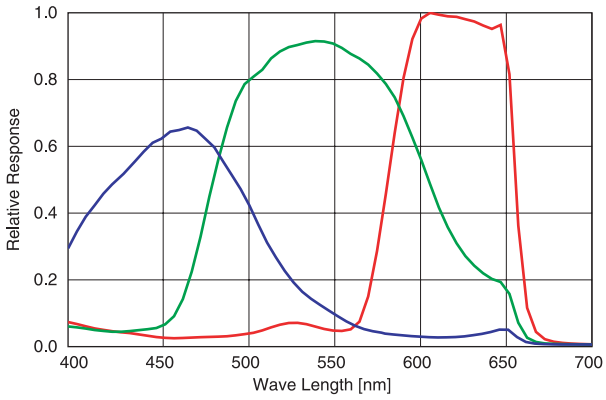
Design and specifications are subject to change without notice.

Spectral Sensitivity Characteristics (Typical Values)

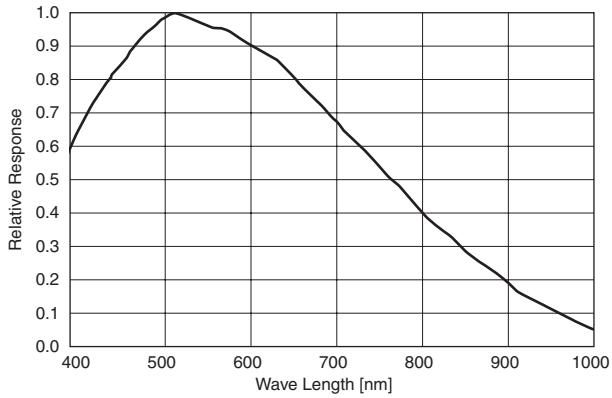
XCG-CG160



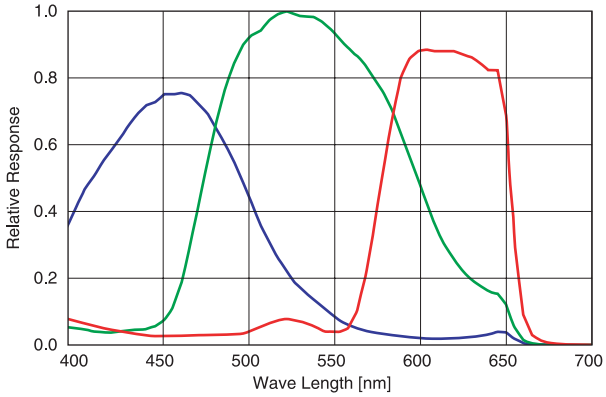
XCG-CG160C



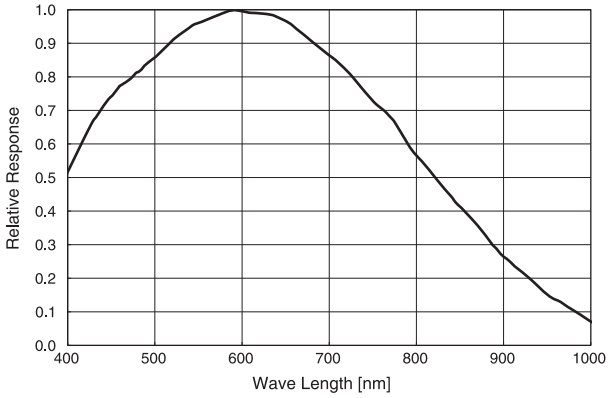
XCG-CG240



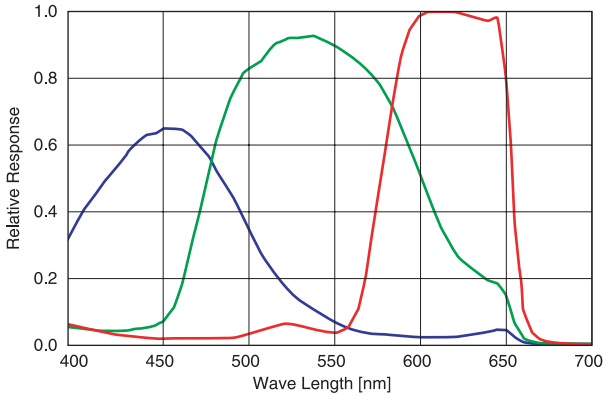
XCG-CG240C



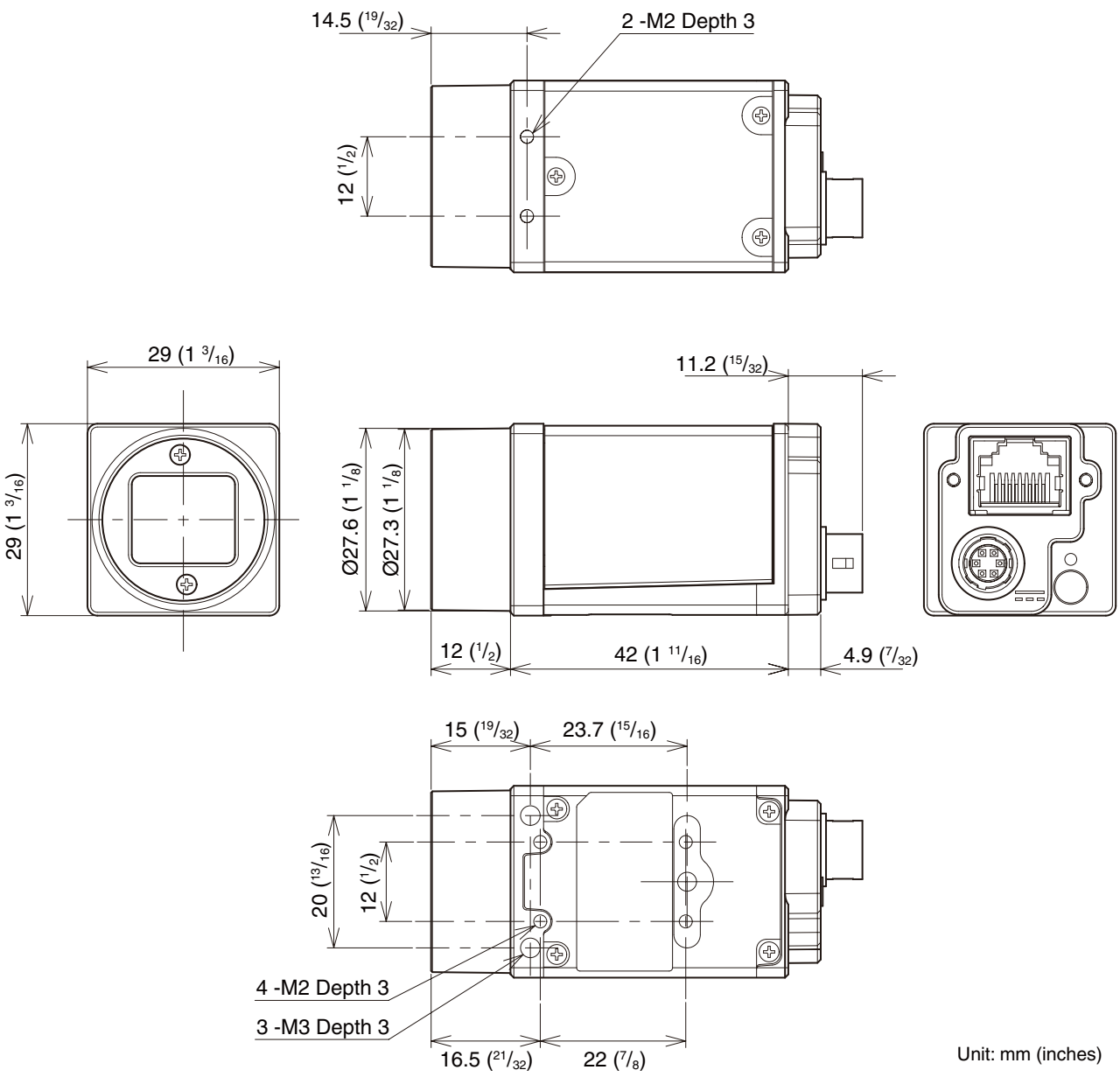
XCG-CG510



XCG-CG510C



Dimensions


14.5 (19/32)
2 -M2 Depth 3
12 (1/2)
29 (1 3/16)
29 (1 3/16)
11.2 (15/32)
Ø27.6 (1 1/8)
Ø27.3 (1 1/8)
12 (1/2)
42 (1 11/16)
4.9 (7/32)
15 (19/32)
23.7 (15/16)
20 (13/16)
12 (1/2)
4 -M2 Depth 3
3 -M3 Depth 3
16.5 (21/32)
22 (7/8)
Unit: mm (inches)

http://www.sony.net/

Sony Corporation